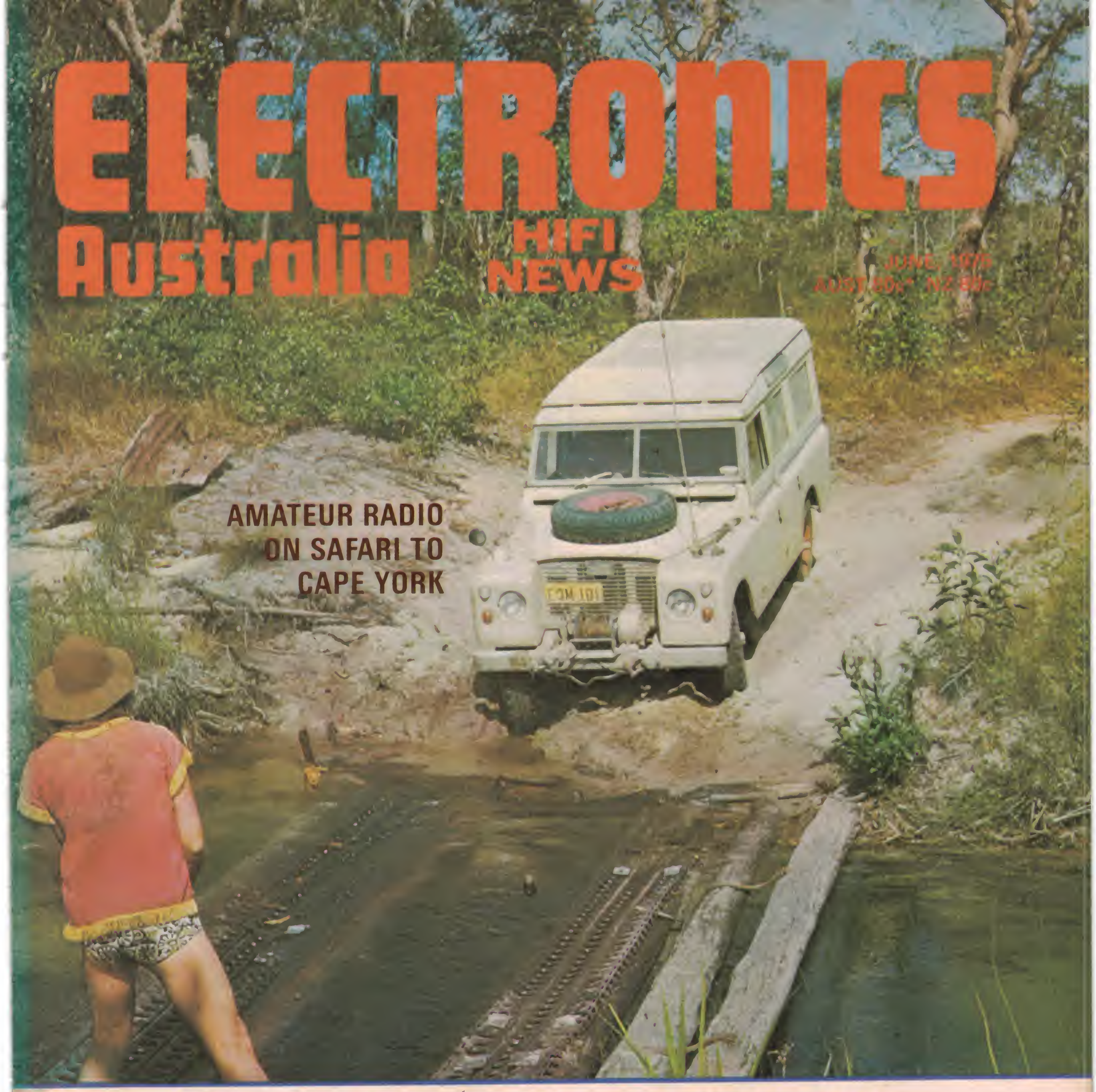
ELECTRONICS Australia

HIFI NEWS

JUNE, 1975
AUST 80c* NZ 80c



AMATEUR RADIO ON SAFARI TO CAPE YORK

THE ROLE OF ELECTRONICS IN ECOLOGY

DOES LOUD MUSIC MAKE YOU DEAF?

USING TWO TV SETS FROM ONE AERIAL

MAKE WEIRD MUSIC WITH OUR "OPTOMIN"

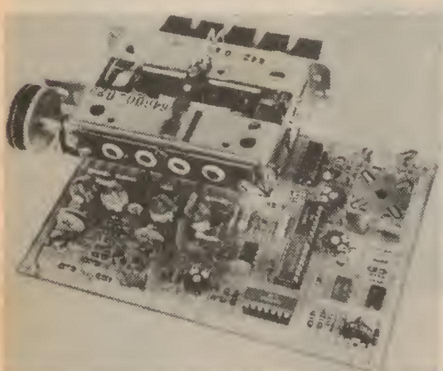
Registered for posting as a periodical — Category B

ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 37 No 3

Yes, we're full of ideas! Staff engineer David Edwards has invented the "Optomin", a new musical instrument that uses reflected light to produce all manner of weird and wonderful sounds. You can read all about the incredible Optomin in our feature article commencing on page 32.



Featuring an unusual "switching" synchrodyne detector with a TRF front end, this advanced AM tuner is capable of high quality reception. Circuit specifications include automatic muting, a whistle filter, low distortion, and wide audio bandwidth. See page 66 for details.

On the cover

Husband and wife amateur radio operators Dick (VK2AZG) and Hebe (VK2AOK) Grouse negotiate one of the many creek crossings during their recent Landrover safari to Cape York Peninsular. This month's amateur notes on page 99 give a brief recount of some of their more interesting experiences.

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Editorial Viewpoint

Challenge: the "Novice" amateur licence

On the 24th of this month, the Postmaster-General's Department will be conducting the first examination in Australia for aspiring "Novice" amateur radio operators and, within a few months, we can expect to hear the first novice level amateur stations on the air. It could be a significant day for the "Amateur Service", which desperately needs a shot in the arm in Australia, as in many other countries.

The culmination of years of negotiation and argument, the novice licence will make it possible for enthusiasts to gain "on air" experience, after passing what the Department calls "a comparatively simple" examination in radio and theory and regulations, and a Morse Code test at 5 words per minute. Successful candidates will be able to operate crystal controlled transmitters, with a useful and convenient power limit, on the 3.5, 21 and 26MHz bands, using CW, AM, FM and "sideband".

As such, the Australian novice licence is more liberal and realistic than its present American equivalent, which limits the holder to code transmission. Australian licensees will be able to gain experience with all the normal amateur band speech modes—a concession which should reduce the temptation to operate instead as a "pirate".

While the new licence is intended primarily to meet the needs of teenage enthusiasts, there is actually no age limit. If a lad can pass the examination, he becomes eligible for a licence. But, equally, mature enthisiasts and SWL listeners who could not cope with the full AOCP examination can grasp the new opportunity.

The word "novice" may have about it an air of condescension but I sincerely hope that established amateurs will not affect to ignore or spurn the newcomers and their humble "home-brew rigs". Big beams and expensive transceivers have their place but there are other ways to enjoy and benefit by amateur radio.

In fact, I see the coming of the novices as an incentive for many old-time amateurs to get back on the air—amateurs who were unable or unwilling to keep up with the Jones' in the amateur ranks. You can rest assured that we at "Electronics Australia" will be doing our best to foster this second level of amateur activity.

And, goodness knows, the amateur movement can use all the help it can muster. While amateurs have been able to hang on to their bandspace reasonably well in the past, tolerance and tradition cannot be taken for granted indefinitely. "Use it or lose it" is a time-worn phrase but it has been resurrected recently in the USA, where amateurs are now facing a massive challenge, not just from government and commercial interests, but from literally millions of CB'ers.

—Neville Williams

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Printed by Dalley-Middleton-Moore Pty Ltd, of Kent St, Sydney and Masterprint Pty Ltd of Dubbo, NSW, for Sungravure Pty Ltd, of Regent St, Sydney.
*Recommended and maximum price only.

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Subscriptions
Subscription Dept, PO Box M204, Sydney Mail Exchange 2012.

Circulation Office
21 Morley Ave, Rosebery, Sydney 2018. Phone 663 3911.

Distribution
Distributed in NSW by Sungravure Pty Ltd. 57-59 Regent St, Sydney; in Victoria by Sungravure Pty Ltd, 392 Little Collins Street, Melbourne; in South Australia by Sungravure Pty Ltd, 101-105 Weymouth St, Adelaide; in Western Australia by Sungravure Pty Ltd, 454 Murray Street, Perth; in Queensland by Gordon and Gotch (A'asia) Ltd; in Tasmania by Ingle Distributors, 22 Argyle St, Hobart; in New Zealand by Gordon and Gotch (NZ) Ltd, Adelaide Rd, Wellington.

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1

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BSR HT70 Three Speed Single Play Turntable.

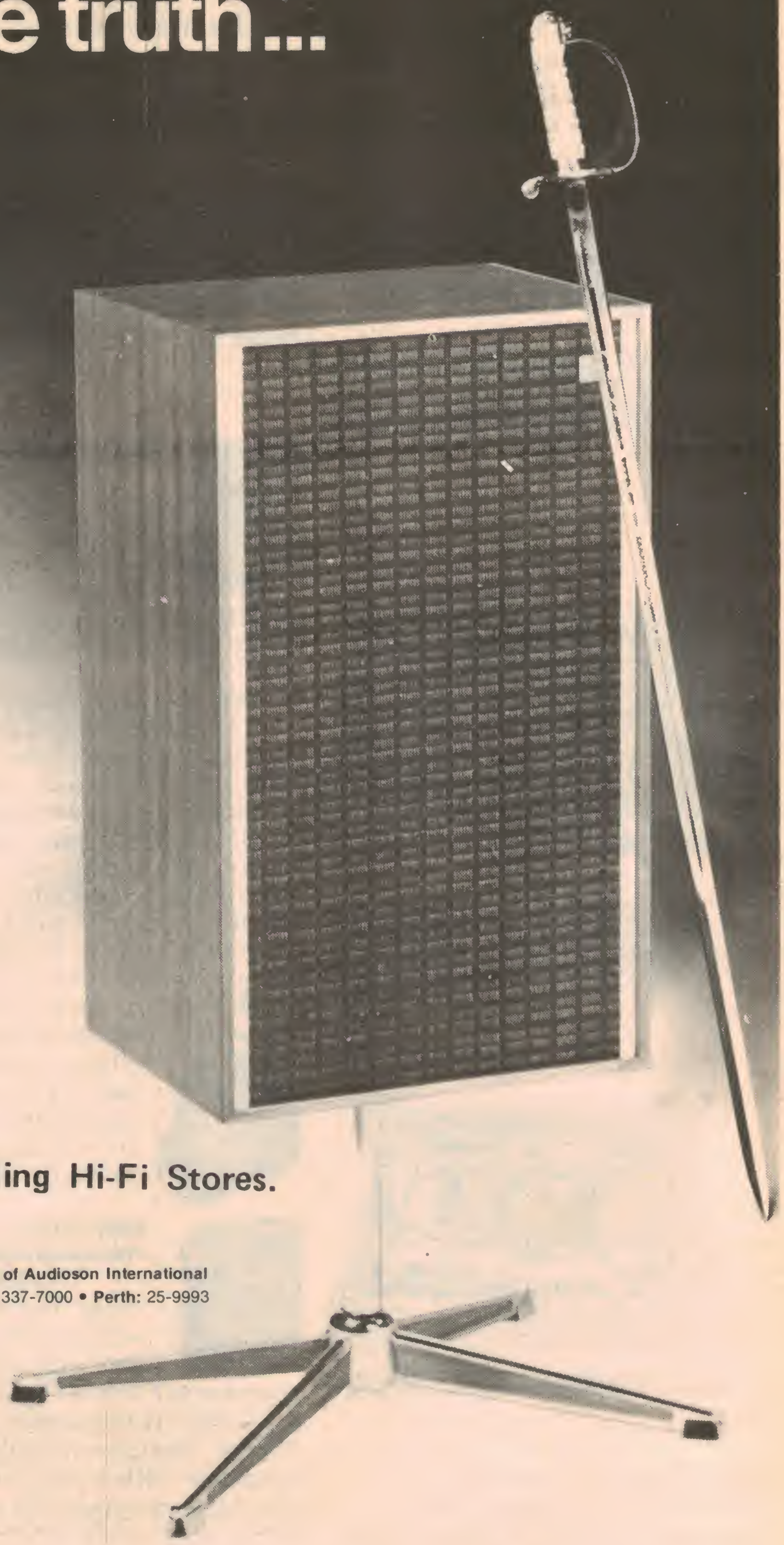
2

This is a high precision luxury player ideal for that select group of enthusiasts who insist on manual operation. It features a deep rim, die-cast turntable weighing 4½ lb, engineered to provide a perfect tracking angle, a rotating stub spindle which avoids centre hole wear on your records, and a fully synchronous dynamically balanced 4-pole motor to lock on to the frequency and compensate for fluctuations in the mains voltage. It features the BSR anti-skate force control and a low mass tone arm supported on ball race bearings, fitted with an ADC K7E cartridge. The unit is mounted in a specially selected quarter cut teak veneer plinth with smoke tinted dust cover.

BSR McDONALD

The range of BSR changers are available at your nearest Hi-Fi store. *Recommended retail price at the time of going to press.

KEF go a long way to defend the truth...



When KEF introduce a new speaker, it's big news. The CADENZA is no exception. Designed for the serious listener, the CADENZA is a sophisticated speaker in which KEF have overcome high fidelity's number one hang up, 'colouration'.
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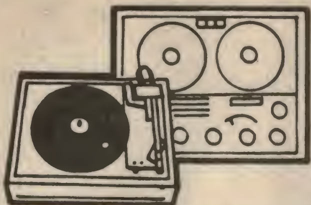


Hi Fi News

New scheme to beat recording "pirates"

The practice of "pirating" commercial recordings has now reached a scale where it is seriously eroding legitimate returns to artists and recording companies alike. A suggested way of combatting the problem is an acoustic "imprint" buried in each recording, which would identify its source and make it easier to enforce copyright wherever warranted.

by NEVILLE WILLIAMS

The problem of unlicensed copying has increased progressively with emerging technology. In a sense, copying has always been possible but it was sufficiently impractical early on, not to be worth the effort.

With the arrival on the scene of domestic tape recorders, it became quite easy for individuals to copy recordings, either directly, or off air. Initially, recording companies were not unduly perturbed. A jumble of items on reels of tape were no competition for packaged discs, so that copies made for purely private enjoyment were virtually conceded "legitimate" status.

The companies' attitude has tended to harden with the increasing use of cassette equipment. Cassette copies of discs and tapes are economical and convenient and, for all practical purposes, technically equal to the original. As noted last month, the scale of private copying in Japan, at least, is such that it is suspected of putting a discernible dent in profitability, particularly of 45rpm "hit" singles, which can so easily be copied off-air.

But the biggest hassle has to do with "bootleg" copies, being marketed on a substantial scale in USA in direct competition with the originals. Audio equipment and facilities are now so widely available that it is relatively easy to make saleable duplicates from discs or cassettes. It has become big business in recent years, bleeding off an estimated $200 million annually from the legitimate operators.

The bootleggers try, as far as possible, to remain anonymous. They prefer to sell through market stalls and small shops with not too many questions asked. If the going gets too hot, they pick other artists, other titles, other brands and other outlets, in an effort to avoid confrontation and prosecution.

However, this is not the limit of the pirates' resources. One trick is to produce a new bootleg master copy on which the items have been fiddled in some way: lengthening breaks, the addition of reverberation or over-recording guitar chords here and there, or snatches of percussion. If challenged, the pirates point to the differences and claim that the recording is a "sound-alike" performance made by different artists.

While the deception may be transparent enough on the surface, it can be difficult and costly to prove in a court of law.

A small company in New York, Audiocom Corp., thinks it has an answer to this particular problem. The brainchild of Murray G. Crosby, of FM-stereo multiplex fame, Audiocom's proposal is a special sub-audible tone injected right into the original master recording. It could be used to identify that recording in whatever form it appeared.

The system involves a narrow notch 200Hz wide centred on 2877Hz and maintained for 2.5 seconds at a selected point in the recording. Within the notch, a carrier 55dB below peak amplitude would carry an 8-character signal code in frequency-shift form. Although inaudible to listeners the code would be plainly obvious to a sensing and decoding device.

Alex J. Rutman, executive vice president of Audiocom sees it as a deterrent to commercial recording pirates but he also envisages a wider market, covering radio and TV sound commercials, which are also fair game for malpractice of one kind or another.

In fact, Rutman envisages a network of monitor receivers tuned to all the major broadcasters and feeding into suitably developed decoders. These could record every play of every copyright track, whether original or dubbed, along with exact time and date. If, as expected, the US Congress legislates to impose a fee-per-performance obligation, the Audiocom system would offer an automatic basis for the charge.

It would also pose a fresh challenge to the pirates to come up with a way of obliterating the code! For the pirates there could even be a spin-off: the usual

Handy stereo, British style: A product of Thorn Consumer Electronics Pty Ltd, this Ultra Stereo-2 unit is equipped to play either stereo records or stereo cassettes—in both cases with auto-stop at the end of play. Despite the slim-line appearance, the designers have found room to store 10 cassettes behind the front-loading deck. The unit is supplied with two matching loudspeakers.

proceeds from direct sale, plus an incentive for broadcasters to "unwittingly" use a proportion of bootleg copies, thereby defeating the "big brother" decoder.

NEW AUST. HOME FOR PIONEER ELECTRONICS

Claiming to be the largest manufacturer in the world of specialised hifi equipment, Pioneer Electronics plan to open a $500,000 complex in the Melbourne suburb of Braeside for their Australian operation. The first stage of the new building will include a head office, sound lounge and a central warehouse, involving about 30 employees. Stage 2 will double the capacity of the building and may house an assembly operation as well.

BSR MARKETING: BSR (A'Asia) Pty Ltd have set up new marketing arrangements for their products in this country.

In future, "Hifi" products distributed by BSR themselves will be distributed to the retail trade through Auriema (Australia) Pty Ltd, 15 Orchard St, Brookvale NSW, telephone (02) 939-1833, telex AA24121. The Hifi products include BSR McDonald turntables (mounted in base and cover); BSR McDonald 8-track cartridge mechanism (mounted); ADC (Audio Dynamic Corp) magnetic cartridges; BSR Electronics frequency equalisers.

The standard range of BSR turntables will be distributed to the retail trade through Expo International Pty Ltd, 47 Buckley St, Marrickville, NSW. Telephone (02) 519-4622.

BSR (A'Asia) Pty Ltd will continue to supply all original equipment manufacturer accounts directly, as before, with all BSR product lines.

Spare parts, including BSR and Tetrad replacement cartridges, etc, will be available through BSR, Auriema and Expo, as well as through other outlets currently being negotiated.

AUDIO-TECHNICA CARTRIDGES: Aiming at maximum impact on the hifi market in the USA, Audio-Technica are offering a complete range of eight separate cartridges to meet all likely requirements. All feature a dual-magnet structure in which each stereo channel has its own tiny magnet, pole pieces and coils, the aim being to achieve optimum and independent response to the sets of channel information.

Cartridges AT10 and AT11 are for budget-priced systems where ruggedness is essential. Both are fitted with an 0.7mil conical stylus, both have a rated response to 20kHz or beyond and both are intended for applications where a high tracking force is mandatory: up to 4 grams with the AT10, and 3 grams with the AT11.

The AT11E and AT12E have elliptical stlyi and wider rated response, with the latter designed for a tracking force of 1.2 to 2 grams.

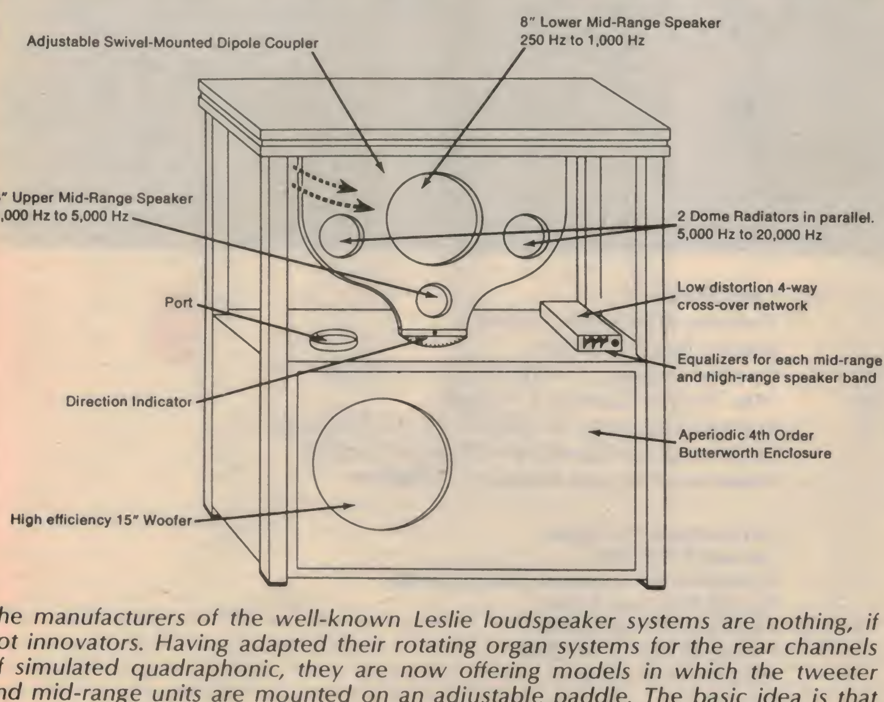
The remaining four cartridges have responses to 45kHz and beyond, being suitable for playing all types of record, stereo, matrix or CD-4. The AT13E has a "nude" elliptical stylus, but the remaining three, in ascending price order, are all fitted with nude Shibata styli: AT14S, AT15S and AT20SL. For further details of the cartridges: Jacoby Mitchell Ltd, 215 North Rocks Rd, North Rocks 2151.

CONFLICT: While a large amount of effort has been directed towards achieving mechanical compatibility between mono, stereo, matrix and discrete recordings, compatibility in terms of the musical content is quite another thing. Producers are apprehensive that a recording intended to sound its best in one playing situation, will do the musicians less than justice if played in another. For the second format a quite different mixdown might have been preferred.

Highlighting the problem, the latest Jethro Tull (CD-4) albums from Crysalis Records, distributed by Warners, carry the usual statement that the discs can be played on 2-channel equipment. However, more prominently displayed is the disclaimer: "It is the opinion of the producer that . . . best results can be achieved only by playing on a CD-4 discrete quadraphonic system. Best results on stereo are achieved by playing a stereo disc."

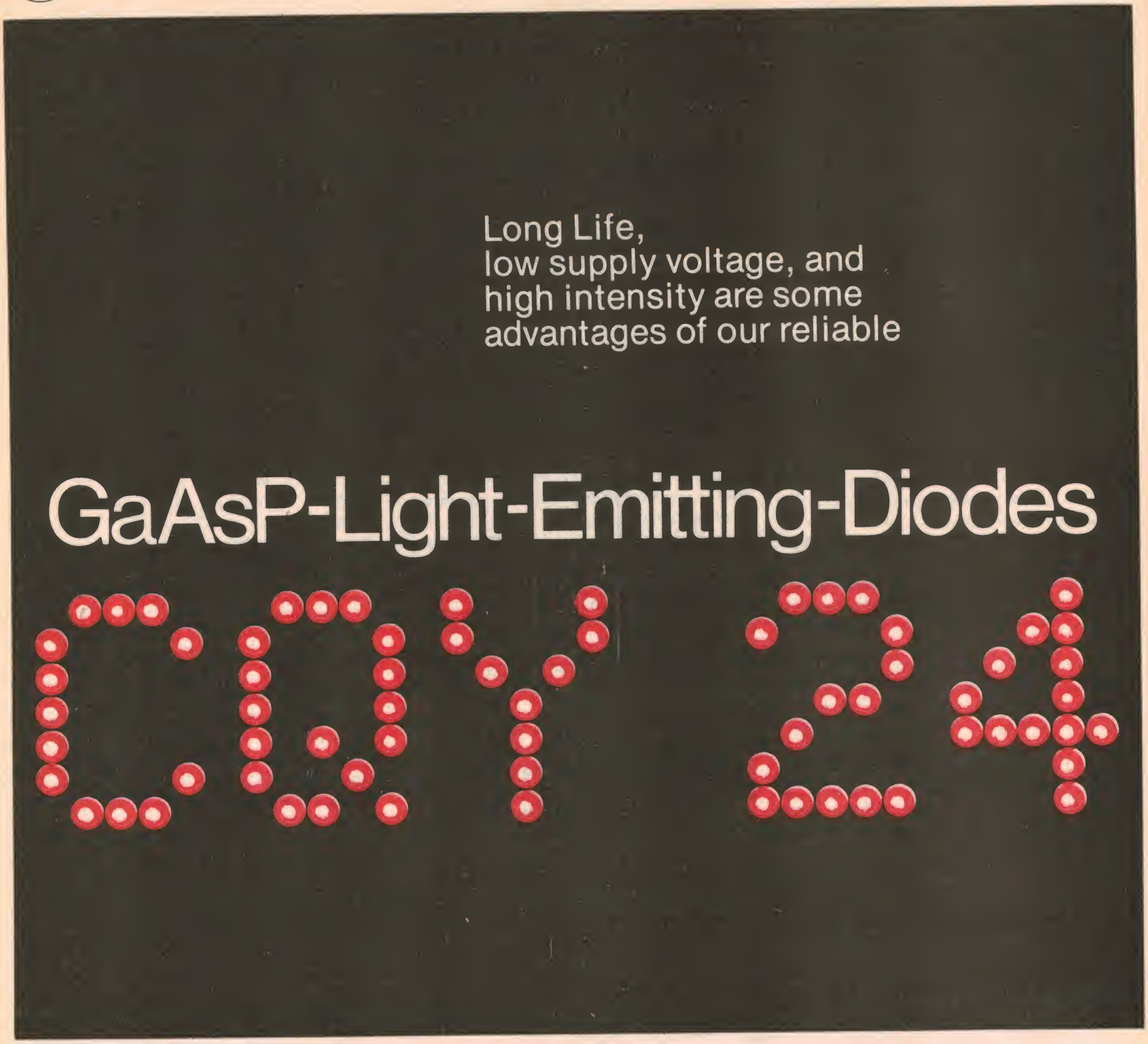
While the aesthetic aspects of "compatible" recordings have been discussed freely in the industry for a long time, this is probably the first time that a producer has actually "warned off" the public. If other producers and companies follow suit, it may force dealers to carry duplicate stocks for two-channel and other systems . . . a situation which they have been trying desperately to avoid.

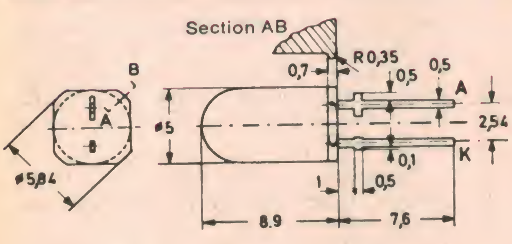
SQ V. QS: Meanwhile sniping continues between the matrix exponents. An engineering report issued by CBS Labs – scarcely noted as "doves" – stated that



The manufacturers of the well-known Leslie loudspeaker systems are nothing, if not innovators. Having adapted their rotating organ systems for the rear channels of simulated quadraphonic, they are now offering models in which the tweeter and mid-range units are mounted on an adjustable paddle. The basic idea is that the enclosure can be positioned to suit the decor, while the speakers can be angled for the optimum stereo image. The bass chamber, essentially open in the rotating model, has given place here to a fully developed ported system. (In Australia: Rose Music Pty Ltd.)

PHILIPS





Case: Plastic
Direction of Radiation: Frontal
Pinning Raster: 2,54mm
Forward Voltage: (I_F = 20mA) U_F = 1,6 (≦2)V
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HiFi NEWS

Sansui's vario-matrix decoder did not provide the same order of performance as the SQ full logic decoder. Commenting on Sansui's claim for the QS-SQ unit, CBS says that vario-matrix gives side channel separation of only 6dB front to back and 3dB back-to-front, as against 20dB provided by SQ full logic.

In response, Sansui spokesmen have claimed that their vario-matrix can give 15-18dB separation between centre front and centre back. They say that this is the vitally important aspect; that logic decoders can't provide centre channel effects. Even CBS credits Vario-Matrix with 14dB centre-front to centre-back.

So the arguments continue.

SOLID-STATE TRANSMITTER: The first five-kilowatt, totally solid-state, AM broadcast transmitter to be introduced in the U.S. is now "on the air" at WIND radio station, in Chicago.

The solid-state transmitter is easier to maintain, lighter, smaller, more efficient, safer and simpler than tube-type transmitters. The WIND transmitter has an excellent frequency response between 30 and 15,000 Hertz and very low audio distortion. Westinghouse Electric Corporation's electronic systems support division, Baltimore, Md., developed the solid-state transmitter now in operation.

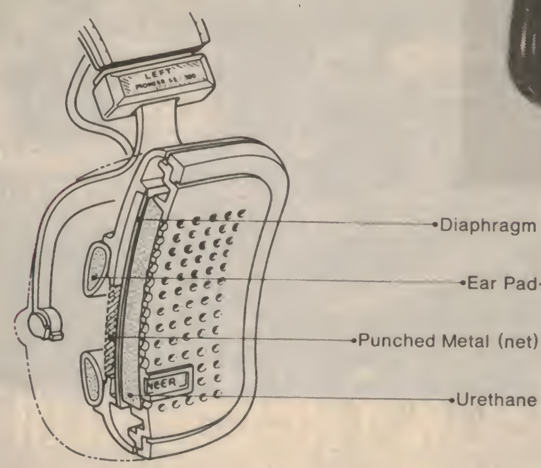
Total weight of the WIND transmitter is 352 kilograms including isolation transformer. This is about 2.5 to 3 times lighter than current tube-type transmitters. Less than 0.8 cubic metre of space is needed for the solid-state transmitter—almost four times smaller than recent tube units. Conversion efficiency (radio frequency power output/line power input) of the Westinghouse-developed transmitter is about 75 per cent compared to about 50 per cent for most tube units.

WIND radio station in Chicago operates at an AM broadcast frequency of 560 kilohertz with five kilowatts of output power. A directional pattern antenna system with four towers is used by the station. (For further information: Sandy Pearce, Charles Barker Australia Pty. Ltd. Tel. No.: Sydney 26 2877).

PIEZOELECTRIC PHONES: A very significant piece of technology appears to have escaped the attention of audiophiles for decades and, even now, seems to be making its entrance via the back door. It is the technology behind Pioneer's "high polymer" stereo headphones.

Ordinary piezoelectric devices have been around for years, with crystal and ceramic phono cartridges probably outnumbering, in toto, all other types. The cartridges rely on a wafer of solid material exhibiting the piezoelectric effect—the production of a voltage between opposite faces when the wafer is subject to mechanical stress. In a cartridge, the stylus mechanism vibrates (and stresses) the wafer in sympathy with the pattern in the groove, reproducing a corresponding signal voltage to drive the amplifier.

Crystal tweeters operate in the reverse fashion: signal voltages applied between the faces of a piezoelectric slab cause it to vibrate, either exciting the air directly or per medium of an attached diaphragm.



Above: The Pioneer piezo-electric "high polymer" phones type SE-300. At left, the internal structure. The manufacturers liken the action to "breathing", as the diaphragm changes its tension around the compliant foam pad.

It is unlikely that many audiophiles would ever have thought of the piezoelectric effect in connection with anything but a rigid piece of material, so that the idea of a piezoelectric membrane or film would be completely foreign. But that is the basis of Pioneer's new headphones, first mentioned in our March issue.

In these headphones, the piezoelectric element is a very thin (6.5 micron) "high polymer" film with electrical contacts on opposite edges. The film is stretched across a convex foam pad and is normally under slight tension. When signal is applied across the film, it changes dimension slightly, increasing or decreasing the tension on the foam pad, and either moving towards or away from the ear. In so doing, it produces the requisite sound waves.

The operation would be closely analagous to electrostatic phones, where a low-mass, non-rigid diaphragm moves in response to variations in an electrostatic field. But, whereas electrostatically driven diaphragms are suspended in free space, the piezoelectric counterpart rests against—and is damped by—a foam pad.

A number of questions follow automatically, but notably: will the foam pad result in a more robust product? Will it impose undesirable limitations in response and linearity? Will it gradually change characteristics over a period of use?

In the meantime, Pioneer stress that their new headphones do not require high impedance high voltage drive, as do electrostatics, nor do they require a polarising voltage. Their impedance and sensitivity is such that they can be plugged straight into most existing stereo headphone sockets.

The phones mentioned in our March '75 issue were designated as type SE-700. The type SE-300 illustrated on this page represents an application of the piezoelectric high-polymer principle to medium priced phones: With a rated frequency range 20-20,000Hz and a sensitivity of 100dB/3V, the SE-300 phones have a recommended retail price of $34.00. Model SE-500, with similar specifications, retails for $45.00.

As will be evident from the photograph and diagram, the SE-300 employs virtually open-back construction. The diaphragm follows the contour of the outside plate, sound being conveyed to the ear through a soft circular cushion which rests against the ear, without enclosing it.

Pioneer Australia stress, however, that release of the new "Hi-polymer" headphones does not displace their established conventional lines.

Convoy International Pty Ltd, Australian Distributors for TDK tape, have announced some changes in State Distributors.
Victoria: *Goldex Trading Company have been appointed TDK Distributors for the State of Victoria. Following the retirement of Mr. Kel Kaires, the company K. J. Kaires & Company have ceased operations.*
N.S.W.: *Goldex Trading Company have been appointed a Distributor of TDK tape for the State of N.S.W.*
Western Australia: *Atkins Carlyle Limited have been appointed TDK Distributors for Western Australia.*
Canberra: *Southside Electronics are TDK Distributors for the A.C.T.*

DOES LOUD MUSIC MAKE YOU DEAF?

It is now well established that if our ears are exposed to excessively high sound levels for long periods of time, permanent hearing damage will result. Modern pop music is often loud enough to constitute a similar risk. But how great is the risk, and what legal limits should be imposed, if any?

by ADRIAN HOPE

It is a sad fact of life that most pleasures are considered illegal, immoral, or make the participant fat. Until recently, music suffered from none of these stigmas, but research into the effects on hearing of large doses of loud noise suggests that modern pop music very probably makes the listener deaf in the long run. In consequence, loud music is now illegal in Leeds and under the Control of Pollution Act 1974 it may well soon be outlawed elsewhere in Britain.

Noise is nothing more than unwanted sound, and sound is conventionally measured in units of pressure or intensity on the ear. The basic unit of sound pressure is the newton per square metre (N/m^2); the basic unit for intensity is the watt per square metre (W/m^2). The ear is such a remarkable instrument that the largest sound that can be tolerated without pain and almost instantaneous permanent damage is five million times the smallest that can be heard at all. Ranges of such magnitude are conveniently measured on a logarithmic scale and use of the decibel enables the safe range to be expressed as the range 0-134dB.

But the ear does not hear every frequency in the same way. If you turn down a record player you will notice that the high (top) frequencies and the bass (low) frequencies disappear far more quickly than the mid-range frequencies. In order that the logarithmic decibel scale may conform more closely to the way in which the ear reacts to sound in practice, dB measurements are made through "weighted" instruments. These simply filter the sound received by the measuring instrument to simulate the natural characteristics of the human ear. There are various weighting scales but that most universally used is the A scale. Thus most measurements of sound pressure are in dBA units and sound level meters usually give a direct dBA readoff.

Sound pressure is analogous with voltage or current in electrical calculations. It is expressed in dB using the formula 20log pressure ratio, with the reference level (0dB) being 0.00002N/m^2. Thus a doubling of sound pressure is written as an increase of 6dBA—96dBA being twice the sound pressure 90dBA.

But just as sound pressure is analogous with voltage or current, so the energy content of sound is analogous with power or intensity. It is expressed in dB using the formula 10log power (or intensity) ratio, with the reference level (0dB) being 10^{12}W/m^2. A doubling of sound energy is written as a 3dB increase.

Not surprisingly, this situation causes confusion in many minds and there is good reason to believe that some of the lay committee members responsible for taking legislative decisions have already unwittingly been misled by guide information which refers sometimes to sound energy and sometimes to sound pressure. It is also probable that confusion has arisen from the fact that it takes a sound pressure difference of 10dBA to cause the ear to hear a subjective doubling in loudness. Witness, for instance, a

carefully written protest in one of the Sunday supplements which explained that an increase of 10 decibels represents a doubling of noise. It does not; it represents a doubling of apparent loudness.

In 1970 HMSO published the DHSS report, "Hearing and Noise in Industry", by W. Burns and D. W. Robinson. As its title suggests, this report was concerned solely with industrial noise, such as the fearful sound created by sheet metal work, and it laid down guidelines for predicting the likely permanent hearing loss which workers will suffer from prolonged exposure to excessive sound levels. This loss results because when the ear is subjected to high intensity sounds, the hair cells are exposed to excessive pressures, and while some may recover their sensitivity others are irreparably damaged.

In 1972, HMSO followed the report with a Code of Practice which laid down exposure time and sound level limits for workers above which damage would unacceptably prove likely. Essentially, the Code suggested that the sound limit should be set not higher than 90dBA if there was to be a continuous daily exposure of eight hours a day. But each halving of the duration of the eight-hour day permits an increase of 3dBA. Thus, with the overriding condition that no unprotected ears should ever be subjected to sound of greater than 135dBA, it is possible to predict that if the exposure is only for four hours the level may safely be 93dBA, for two hours it may be 96dBA and so on.

But the report and Code of Practice both recognise that the predictions hold good only where the sound level is continuous and reasonably steady (never fluctuating by more than 8dBA) and it is not usual to find noise so steady. It was thus suggested that the equal-energy principle should be adopted. This integrates the effects of various sound levels over various exposure times to produce an equal energy value (Leq) which can be used for risk calculation purposes exactly as if it were a continuous sound level reading.

It was in the late 1960s that pop groups took advantage of new amplifier and loudspeaker technology to play louder and louder for more and more people at any one time. Not surprisingly, some amplifier and loudspeaker manufacturers were happy to oblige the rock groups in the power race that soon became a vicious circle. As open-air audiences became larger, so more power was needed.

The famous Woodstock Festival in the US used 1,000 watts of amplification; the Isle of Wight and Bath Festivals in Britain used 2,000 or 3,000 watts, and amplifier rigs of 9,000 watts are now used for public address. Powers of this order are relatively safe when correctly used in the open air. However, if the speaker banks are not mounted well above audience head level, the front rows will be subjected to dangerously high sound levels.

Some points of reference

It is all very well to talk about and define dBA, but to most of us dBA measurements mean nothing unless referred to everyday sounds. Customary points of reference are a just audible sound (0dBA), a quiet bedroom in the middle of the night (35dBA), a busy shop (60dBA), a fairly noisy workshop or factory (85 or 90dBA), a tube train entering a station (95dBA), and a jet plane at 200 metres (120dBA). But more relevant to the present context are the following:

- A television or radio at normal listening level will be between 60 and 65dBA. If it is loud it will probably reach 70dBA. A live performance of Beethoven's 9th can produce an occasional 105dBA in the front row.
- Normal cinema levels are in the dBA70s, but at the front of the Empire Cinema in Leicester Square, London, recently the Sensurround Earthquake effects went right off the scale of my meter and were thus well over 110dBA and probably in the order of 120dBA or more.
- To run a domestic sound system at 100dBA requires a powerful system and thick walls or a detached house. Alternatively you might employ a good lawyer.
- Pop groups regularly produce 110dBA and can often clock up peaks of 120 and 130dBA. Monitoring in pop recording studios may be at 120dBA and levels of 128dBA are not unknown. The sound pressure at the mouth of some of the reproducer horns used by pop groups is 140dBA, which is physically dangerous to anyone close to them.
- Perhaps most important of all in the context of the current move towards legislation is the fact that even a cheap stereo system can easily produce levels of 100dBA at the ears of a listener if headphones are used. Thus whatever legislation is passed the pop fan will still be able to deafen himself without even disturbing someone else in the same room.

Also, many groups are now using their open air systems indoors. The Grateful Dead, for instance, played Alexandra Palace last year with a sound system which was claimed to weigh 30 tons, to comprise 641 speakers and to have an output of 26,400 watts RMS.

No one doubts that if Burns and Robinson are correct in their predictions over hearing loss from industrial noise there must also be a risk to pop fans subjecting themselves regularly to the sound pressure levels that equipment of this type produces.

In 1970, World Medicine (vol 5, no 23, p 21) conducted a survey on the hearing of some prominent pop group musicians, but found difficulty in coming to any positive conclusion and suggested that "on the whole our small preliminary investigation gives no cause for alarm". More recently, in Leeds, R. W. Fearn, principal lecturer in the Department of Architectural Studies at Leeds Polytechnic, came to a very different conclusion.

Working with sound level meters through the youth clubs in the West Riding of Yorkshire, Fearn found that the levels of sound being played either by groups or by disc jockeys were often up to 110dBA (Leeds Department of Architecture reports nos AS71/5 and AS72/7). Fearn believed that the Burns and Robinson predictions made this clearly a risk to regular attenders and he carried out an audiometric survey of 316 young people in the Leeds area.

Disregarding those with a known history of other noise exposure and those with diseased ears, Fearn obtained 102 audiograms of regular listeners to loud music and 53 controls of non-listeners. He interprets his findings as confirming the Burns and Robinson predictions, the disco attenders he tested having on average a 3 or 4dB greater loss than the non-attenders. Moreover, 10 percent of the population probably had ears which are more sensitive to damage than the remaining 90 percent and Fearn found that at a once-a-week attendance, 10 percent of the attenders tested had a loss of 14dB or more.

The loss was mainly in the speech frequencies, rather than at 4kHz, as is more normal from industrial noise. This makes such loss particularly alarming. It is perhaps worth noting that a 3 or 4dB loss of hearing is insignificant, but a 25dB loss means the beginning of difficulty in understanding speech and anyone with a 30dB loss will probably soon need a hearing aid.

The Anti-Pollution Sub-Committee of the Leeds Health Committee was already concerned about noise pollution and, using Fearn's research as a basis for action, took advantage of the leeway given by the Leeds Corporation Act of 1906 to impose sound level limits on all local discotheques and concert halls.

Although Burns and Robinson and the HMSO Code of Practice clearly recommend the use of Leq (equal-energy) measurements when imposing limits on sounds which are not continuous, Leeds argued on two main counts against the use of Leq. First, it is impossible to know what other noise disco attenders have been subjected to during the day. Secondly, most pop music has a relatively small dynamic range (it is effectively continuous in its pounding energy content). Thus Leeds imposed a limit on the maximum sound level which can be created by any record reproducer or pop group, rather than on Leq level.

LOUD MUSIC

At first a 90dBA or a 93dBA maximum limit was mooted, but as this would in most cases have put the level of music at only slightly above the level of ordinary background club noise, it was dropped and a 96dBA level limit imposed. The limit has been in force now for over a year and has created a furore of (mostly adverse) public opinion.

Much of the criticism is ill informed and hysterical, and ignores the obviously sincere motives behind the Leeds decision to do something before too many youngsters suffer permanent damage to their hearing. However, Sandy Brown Associates (12 Conway Street, London W1P 5HP) has produced a detailed report and attack on the Leeds legislation. Brown's "Hearing, Health and Music" was commissioned by the Association of Ballrooms who, like many other people involved in entertainment in Leeds, have found the 96dBA maximum level virtually impossible to comply with in practice.

The Leeds limit is enforced by local authority health inspectors armed with Brüel & Kjaer sound level meters. The inspectors use a brief averaging technique (details of which Leeds will not disclose for publication) which is supposed to avoid the absurdity of a brief musical crescendo landing a concert promoter in court. So far it has, but there is also no loud music in Leeds now. The entertainment columns of the local papers listed not one pop concert for the Saturday after Christmas.

In a recording studio (right) the musicians make only relatively quiet sounds. However, in the control room (above) these sounds are monitored at very high levels, with consequent hearing risk.

Sandy Brown argues that it is not reasonable to regard pop music as continuous sound and thus the legal limits must be in Leq units, not maximum levels. He has also pointed to two sound traces released to the author by Leeds which respectively show a dynamic range of 27 and 37dBA. Brown calculates that the Leq for these traces would be respectively 5dBA and 9dBA below their readings in maximum level units. He argues that such discrepancies cannot be ignored.

Leeds local authority is currently refusing to comment to the press. But R. W. Fearn has published a letter in Physics Bulletin (vol 25, p422) which infers that he at least now regards the use of Leq as acceptable. The use of a reasonable Leq limit (Sandy Brown suggests 100; Fearn skirts the issue—but both agree more research is needed) would outlaw only those groups which play ridiculously loudly with no semblance of musical light and shade. For instance, groups could hit maximum levels of around 103dBA but still notch up a Leq over the whole evening of only 93dBA, or 3dBA below the current Leeds limit.

Whether Leeds will make the trade-off is clearly necessary between, on one hand, protecting youthful ears, and on the other hand, driving deliquent youth out on the streets in search of alternative amusement, remains to be seen. But even more important is the action that other local authorities may now take under the 1974 Control of Pollution Act. This gives local authorities wide powers to curb noise in public places and although some people see the Act as concerned only with noise leaking out of establishments and causing a nuisance, it seems likely that a local authority can use the Act to enforce sound level limits inside premises under its jurisdiction.

Already the GLC has published a report "Noise and Music", which lays the groundwork for an Leq level limit of 90dBA spread over eight hours, which would put a 96dBA limit on a two hour concert. But as many concerts and disco sessions last far longer than two hours, this could in practice prove a grossly over-protective limit. And the report explains that one minute at 105dBA would require 32 minutes at less than 90dBA to maintain the overall Leq.

Unfortunately, the 1974 Pollution Act gives no guidance on the actual sound levels to be imposed. Thus local authorities will be forced, like Leeds before them, to leave decisions in this highly complicated area to lay committees. Such decisions will inevitably be open to question.

The background notes supplied to the non-technical Leeds committee to help them understand sound level readings referred throughout to sound energy. The notes thus quite correctly explained how 96dBA is four times as much energy as 90dBA. But the Bye Law enacted deals with sound pressure and when the health inspectors measure a sound level they use a sound pressure meter on which 96dBA is twice, not four times, a sound level reading of 90dBA. This possibly explains the over-protective limit imposed in Leeds.

One can only hope that when other local authorities around Britain impose sound level limits they will bring in expert technical advisers to ensure that value judgments are not made on the basis of technical misconceptions. At a time when we are freely permitted, even encouraged, to drive, drink and smoke ourselves to death with impunity, the decision to forbid us the right to deafen ourselves a little should not be lightly taken.

Reprinted from "New Scientist", by arrangement.

High Performance Belt-driven Turntable from Japan: Micro Solid-50

For those in the market for a high-performance direct-drive turntable here is a belt-driven alternative which is claimed to have equivalent or better performance. It is the Micro Solid-5, which originates in Japan.

While at first glance the Micro Solid-5 looks very similar to many other manually operated turntables it is quite different in several aspects, not the least being its performance. Overall dimensions of the unit are 466 x 142 x 342mm (W x H x D) and weight is 9.3kg.

About 60mm clearance is required at the rear of the unit to allow for the tinted dust cover when it is in the fully open position. The spring-loaded hinges of the cover are slotted into the perspex so it can be easily removed at any time for cleaning.

Described as a servo belt driven turntable, the Micro Solid-5 actually uses a low-speed feedback-controlled DC motor to drive the platter via a 5mm flat belt. From the wiring of the unit, it seems apparent that the motor has its own tacho-generator which the control circuitry uses to keep speed within fine limits.

Speed change is accomplished electronically by the lever on the right-hand side of the deck. Independent fine speed adjustment of the two speeds (33 and 45rpm) is provided by the two small knobs at the front of the deck. We would prefer to see these controls less accessible because they would seem to be prone to frequent "adjustment" by the younger members of the household. Overall range of speed adjustment is plus or minus 6%.

A relatively heavy balanced diecasting weighing 1.5kg is used for the platter. This carries four sets of strobe markings on the rim to allow the speed to be set against the mains reference provided by the neon lamp on the left-hand side of the deck. The four sets of markings are for operation at 50 or 60Hz mains frequencies.

A well-shielded multi-tapped transformer allows the unit to be used at virtually any mains voltage from 100 to 240VAC.

The deck is made from a "sandwich" of 30mm particleboard plus 10mm of plywood and the lot is attractively veneered. Is this where the name "solid" arose? The shock absorbent mounting feet are adjustable for height and a small spirit level is provided on the deck (just near the headshell) as an aid to accurate levelling.

An unusual "scalloped" headshell is fitted to the tone arm. The headshell is removable and has the standard EIA locking collar although it has deeper knurling than usual which makes it easier to screw up firmly. The cartridge mounting screw holes are slotted for stylus overhang adjustment and standard colour coding is used on the cartridge leads.

Longitudinal balance and stylus tracking force setting on the arm are provided by the rotating counterweight. Anti-skating force is provided by a small dial near the arm hub. Also near the arm hub is a long thin lever which is the cueing device. This is damped on both lifting and lowering so the cartridge suspension is always gently treated.

The tone arm has low bearing friction and gives excellent performance when fitted with a high compliance cartridge. Tracking force calibrations are very close to the mark and anti-skating seems close to optimum when judged by comparing waveforms in both channels when the cartridge is tracking heavily recorded sine waves.

We found that the turntable and its controls operated smoothly and quietly at all times. The motor has plenty of torque and brings the platter up to speed very quickly. One point we did notice about the fine speed controls is that the knob for the 33 rpm speed had a considerable "dead spot" in the centre of its rotation, whereas that for 45 rpm was smoothly progressive in its effect over the whole range.

Micro rate wow and flutter at the low figure of 0.035% RMS. We measured it at about 0.15% weighted according to DIN 45507. Although the DIN method gives a higher figure than the "RMS" method, it is perhaps more realistic because it takes into account peak deviations in speed which the ear is presumably sensitive to. At any rate, a figure of 0.15% for wow and flutter is very creditable and is quite competitive with the best direct-drive turntables.

Rumble performance was not so easily verified as it is difficult to make a measurement in our laboratory, which is situated in a very rumble-prone building. As a test of the main-bearing freeness, we disengaged the drive belt and spun the platter up to 33rpm. It took 32 seconds to come to a stop, which is a good figure though not the best we have seen. Unfortunately, this test does not necessarily indicate rumble performance.

Measurements aside, the unit does seem very quiet and would seem to have a virtually rumble-free performance.

Total cable capacitance in each channel is 90pF so it is possible to install a cartridge for CD-4 operation.

Our sample was fitted, with a two-core flex and two-pin plug. We point this out because much equipment from Japan in lower price brackets is fitted with three-core flex and approved three-pin mains plug as a matter of course. It would not be unreasonable to expect the same from this turntable, which is by no means a low-priced unit.

Apart from the above remarks we had few quibbles though, and found the Micro Solid-5 turntable a high performance machine with no unnecessary frills.

Suggested retail price of the Micro Solid-5 is $330 which does not include magnetic cartridge. Further information on the unit can be obtained from International Dynamics (Agencies) Pty Ltd, 23 Elma Road, North Cheltenham, Victoria, 3192. (L.D.S.)

Give yourself plenty of 'scope.

10 MHz ADVANCE OS250 Dual Trace Oscilloscope

BRIEF SPECIFICATIONS

Display: 5 in flat faced CRT giving 10cm x 8cm display EHT — 3.6 kV overall.

Vertical Deflection: Two identical input channels. Y1 and Y2. **Bandwidth** (—3dB) DC—10MHz. **Sensitivity** 5mV/cm to 20V/cm in 1-2-5 sequence. **Input Impedance** 1M Ω/approx. 28pF. **Input Coupling** DC-GND-AC.

Display Modes: **Single Trace** Y1 and Y2. **Dual Trace** chopped or alternate modes, automatically selected on timebase switch. Chop rate approx. 250kHz. **X-Y mode** with Y1 input giving X deflection and Y2 input giving Y deflection. Bandwidth DC to 500 kHz $<$ 3° phase shift at 200 kHz.

Horizontal Deflection. **Timebase**—1 μs/cm to 0.5 s/cm in 18 ranges (1-2-5) sequences. **X Expansion** —X10 pull switch gives fastest speed of 100 ns/cm. Variable control gives $>$ 2.5:1 reduction in sweep speed.

Trigger: Variable level control with option of bright line in absence of signal. **Source** Internal Y1 + or —
Y2 + or —
External + or —
Coupling AC, AC fast TV Frame. **Sensitivity** Internal 2mm approx. 40Hz-2MHz. External 1V approx. 40Hz-2MHz. Internal 1cm approx. 8Hz-10MHz. External 5V approx. 8Hz-10MHz.

Additional Facilities: Calibrator 1V ± 2% square wave at supply frequency. Dimensions .18cm(7″) x 29cm(11¾″) x 42cm(16½″). Approx. 7 kg.(15 lb).

Plenty of 'scope is what you get with Advance OS 250 in **two** ways. First, it's a lot of 'scope for the money. Second, it's got the versatility—with 10 cm x 8 cm display—for a wide range of laboratory, educational, TV and servicing applications.

It features two identical input channels with a maximum sensitivity of 5mV/cm and a bandwidth of DC to 10MHz. The two channels may be viewed separately, alternately at fast timebase speeds, or chopped at a 250kHz rate at low timebase speeds.

Particular attention has been paid to trigger performance, and the system used includes a variable control with bright line operation in the absence of a signal, or when the trigger level is outside the range of the input signal.

Ask for further details now from Sole Australian Representatives:

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Audiosound Motet 2 "improved" loudspeaker system

Back in December 1973 we reviewed the Audio-sound Motet II compact loudspeaker system and found it "big value in a small package". Eighteen months later the improved version is even better value for

"Motet" is a musical term defined as a polyphonic musical composition of an ecclesiastical nature and usually sung without accompaniment. As the name of a loudspeaker system it is certainly quite appropriate and more in keeping with the purpose of a device for music reproduction than some of the trendy monikers we have seen in recent years.

As such, the name of the loudspeaker system tends to convey some of the idealism that this particular manufacturer applies to his product. That is not to say that he is not motivated by the "profit incentive".

But perhaps if he was a little more mercenary and obtained the services of a skilled industrial designer to dress up the exterior of his products, he could get away with less effort put into the interior. We do not for a moment suggest that he do this, but maybe if the products were better styled they would gain more of the recognition they deserve.

So the appearance of the Audiosound Motet is spartan when compared with the products of many other manufacturers. Dimensions of the cabinet are 220 x 370 x 200mm (W x H x D) and it is finished in oiled teak or walnut veneer. The grille cloth is a scrim material available in black, white, green, blue or gold. The rear panel is finished in matt black and has an insulated terminal block for amplifier connection.

The tweeter is a 25mm dome unit with a large ferrite magnet while the hefty little woofer has an effective cone diameter of only about 70mm. It has a roll surround, which is mandatory in a woofer of such minuscule dimensions.

Rugged construction is a feature of the enclosure and great attention has been paid to sealing. All joints and the peripherils of the driver units have been

sealed with a non-hardening compound. Bass response is reinforced by the tuned port while internal reflections are minimised by acoustic filling.

A complex cross-over network is used to couple the signal to the drivers. Each driver has its own impedance and phase equalising network to ensure that the cross-over network proper gives the predicted roll-off rates. The network consists of air-cored coils wound with heavy gauge wire, polyester capacitors and wirewound resistors.

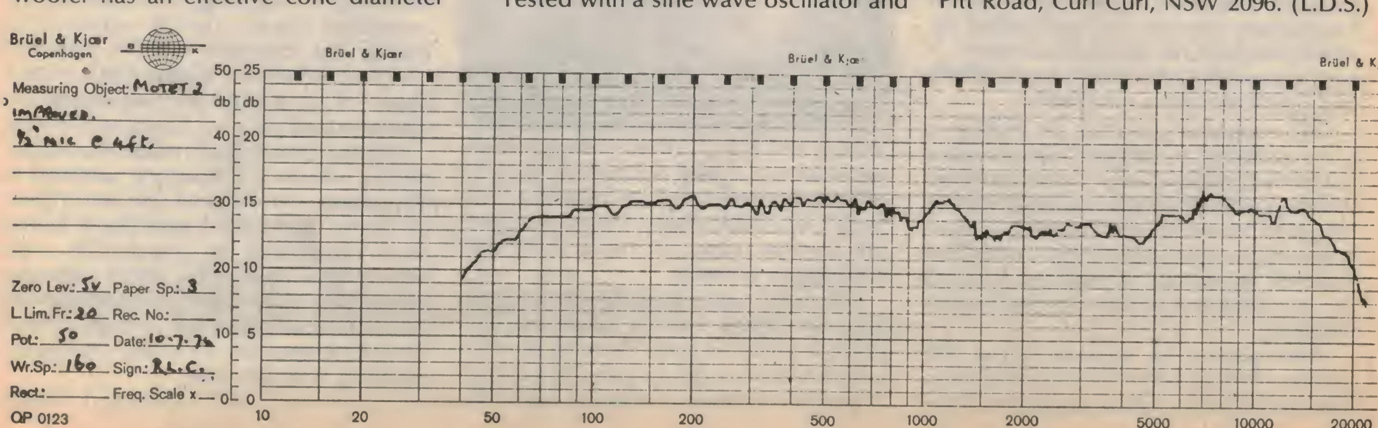
Tested with a sine wave oscillator and high power amplifier we found the frequency response of the Motet to be very smooth and without any tendency for the tweeter to become prominent. If anything, the level could be lifted slightly. Still, that is probably a careful compromise.

Our findings tend to confirm the frequency response curve shown below. This was supplied by Audiosound and was measured with the system buried so that the baffle was flush with ground level. The curve shows a very smooth response from 60 to 16kHz, within plus or minus 4dB.

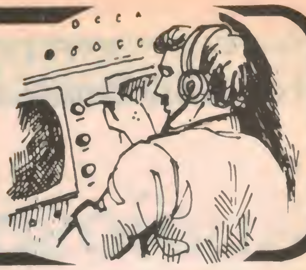
On music signals, the Motet II gives a surprisingly good performance, especially when compared with much larger systems. Power requirement is a minimum of 20 watts per channel but the Motet will handle the output of amplifiers up to 40 watts on music signals. As with the previous model, bass boost is unnecessary with most program material although judicious bass boost can be used—too much and the woofer overloads.

Overall, the Audiosound Motet II "improved" does perform very well and is the ideal choice where compact loudspeakers are required. Perhaps it could be made even more attractive to the buyer with little space, though, by recessing the rear connections and providing hardware for wall-hanging.

Price of the Audiosound Motet is $135 for a pair. This is quite a small increase over the price of eighteen months ago. Further information and demonstration can be obtained from Audiosound Electronic Services at their showroom, 148 Pitt Road, Curl Curl, NSW 2096. (L.D.S.)



News Highlights



Schoolboy cracks computer time sharing security

A 15-year-old schoolboy completely cracked the security system of a major London computer time-sharing service several months ago, gaining access to secret files stored in the computer by other users. The schoolboy, Joe, worked on the project for just four months, his sole access to the computer being the teleprinter terminal at his school.

Most clients of the time-sharing service involved use a terminal which is not permanently connected to the computer. Access to the computer is gained by dialling into it using the normal telephone system. After reaching the computer, the users must identify themselves by giving an account name and password.

The trick Joe used was to listen to the sign-on procedure to learn the account name and password of highly privileged users, and then pretend to be them in order to gain access to secret files. However, this required a long series of steps.

First, Joe discovered that there was nothing to stop him from reading the computer's main memory, although he could not gain direct access to user files. So he wrote a program to provide him with a printout of the operating system—the software which controls users' programs, terminals, etc. Armed with this information, Joe was able to devise a second program to print the line number and account name of every terminal using the time sharing system at any given time.

Thus, by running this program a number of times, he was able to obtain a complete list of account numbers. All that remained was to learn the critical passwords, and the only way to do this was to eavesdrop on users when they first began to use the computer and actually used the password.

For each line, a time-sharing computer has a buffer—a small section of memory that stores data coming from the terminal for a short period until the computer can use it. Studying his operating system printouts, Joe discovered that the computer had a simple rule for assigning the next line. All he had to do was watch the buffer on that line, and print out its contents as soon as a user signed on.

Using this method, Joe was able to gain the password for individual clients. However this method had a major disadvantage in that Joe had to be eavesdropping when a user first signed on.

His coup-de-grace was enacted when he was able to discover a master password.

In common with most time-sharing systems, clients were not allowed access to each other's files. However, a few users, such as system administrators, have special privileges and can examine all files. It was only a matter of time until a privileged user logged in, and Joe was away.

He had the power to completely take over the system, cutting off other users, changing passwords, and even altering the bills that customers would have to pay.

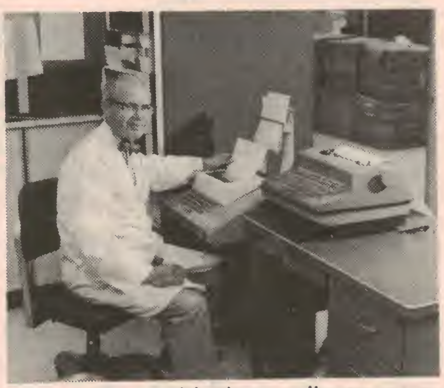
In fact, Joe never did anything much with his privileged account numbers. He simply wrote to the time-sharing service and told them what he did. And although he never received a personal reply, Joe at least had the satisfaction of seeing a new operating system introduced not long after his letter was written.

Computerised bibliography service

A biochemist in Buffalo, New York, is using his privately-owned Varian computer to compose and distribute a unique weekly survey of hematological literature. His publication —"Current Literature of Blood"—is read by subscribers on six continents.

Dr Charles Bishop, director of the Biochemistry Laboratory at Buffalo General Hospital, has been operating his Blood Information Service and publishing his weekly bulletin for about seven years. A typical issue lists about 200 new scientific and medical papers on blood.

The computer used by Dr Bishop is a Varian 620/I, a compact but powerful unit developed by Varian Data Machines. It is the central element in a small system that also includes a card-reader, a Teletype terminal and a computer-controlled Selectric typewriter. Dr Bishop owns all of his equipment, which is housed at the hospital.



In preparing his weekly listing, Dr Bishop reviews some 50 scientific journals published in various languages from all over the world. Three colleagues survey scores of additional publications, by reviewing listings such as "Current Contents"—a weekly digest that reproduces the contents pages of more than 1,000 life-science journals.

For each paper bearing on hematology, Dr Bishop and his single assistant prepare punched cards showing all of the information needed to cite the paper in "Current Literature of Blood." Each citation shows the title and authors of the paper, the title and number of the publication in which the paper appeared, and the address to be used in requesting reprints. A code number indicating the subjects covered in the paper is also given.

By Wednesday morning of each week, the cards have been punched and sorted by code number. They are then read into the 620/I, which prints out the punched information on an IBM Selectric typewriter. As it is printing each citation, the computer checks to see whether Dr Bishop has indicated on the punched card that he wants a reprint of the original paper. If so, a postcard requesting the reprint is printed on a Teletype terminal.

The Selectric listing is taken to a nearby printer, where it is optically reduced to 80 percent of its original size, and reproduced by the Multilith process. A typical issue comprises 16 pages (5½ x 8½ inches) plus covers. By Friday morning, production of the issue is completed and the 620/I has prepared a mailing label for each subscriber. By Friday afternoon, the issue is in the mail.

—George E. Toles.

Circular bar graph for Self-Scan range

A third member of the family of Self-Scan flat panel display devices has recently been released by the Electronic Components Division of the Burroughs Corporation. The new display is a circular, 120-element bar graph with an elongated marker every fifth position.

This unique device is part of the Self-Scan series of digitally-controlled analog displays, and will find use in a range of diverse panel meter applications. These applications include depth, level, pressure, speed and volume indicators, as well as all types of process control gauges. The display uses an easy-to-see orange neon glow, is flicker free, and is easily read in bright light conditions.

Main advantages of the Self-Scan bar graph display over conventional meter movements include high visibility and extreme accuracy, comparatively low cost, and the ellimination of shock and vibration effects. The drive electonics uses off-the-shelf components and is also relatively low in cost. Only nine external connections are required to control the display.

Sample prototypes are available immediately at around $100.00 each. Initial production quantities, due to be released in the second quarter of 1975, are expected to sell for around $29.00 each in quantities of 1000. Units can be provided in special shapes and configurations for custom applications.

For further information on the Self-Scan panel range contact CEMA (Distributors) Pty Ltd, 21 Chandos St, Crows Nest, NSW 2065.

Situated at 125 York St, Sydney (less than 100 metres from Town Hall station), this new 'Electronics Centre' was opened last April by Dick Smith Electronics Pty Ltd. Managed by Bob Johnstone, the new store carries a full range of components, test gear and hifi equipment, and caters for the needs of both hobbyists and professionals. Dick advises, however, that mail order business will continue to be handled exclusively at the Gore Hill headquarters.

US Viking spacecraft to soft-land on Mars

The National Aeronautics and Space Administration (NASA) will launch two spacecraft to Mars later this year, to soft-land on the surface and test for signs of life.

Called Viking, the two spacecraft will travel some 700 million kilometres through space on nearly a year's journey, arriving when the planet is about 330 million kilometres from Earth on the other side of the Sun. Each of the 3,400 kg craft will be launched from Cape Kennedy, USA, by a Titan III/Centaur rocket during a 30-day launch period between mid-August and mid-September 1975.

After confirming a suitable landing site from orbit, each of the spacecraft will separate into two parts—an orbiter and a lander. The lander will then soft land on the Martian surface using parachutes and rocket engines to slow its descent. Once on the surface, the two landers, together with the orbiters, will conduct scientific studies of the Martian atmosphere and surface.

Colour TV camera uses CCD imaging devices

RCA recently demonstrated broadcast television's first "tubeless" TV camera to produce colour pictures from solid-state image sensors known as charge-coupled devices.

The experimental camera uses three postage-stamp size CCD's — one for each of the red, blue and green components of the picture — instead of the three pickup tubes used in most conventional colour cameras.

The demonstrations were held for broadcast industry leaders as part of RCA Broadcast Systems' equipment exhibit at the National Association of Broadcasters annual convention held last April.

Neil Vander Dussen, Division Vice President, Broadcast Systems, characterized the demonstrations as "a progress report to broadcasters on the developing technology from which their future colour TV cameras may evolve".

"While the experimental colour camera represents a very significant development, its pictures are not yet of broadcast quality nor does it have adequate sensitivity," he said.

Mr Vander Dussen estimated that it would be the late 1970s at the earliest before an all-solid-state colour TV camera would be acceptable to the broadcast industry for even the least demanding applications.

Future colour cameras employing the solid-state imaging device rather than tubes could be smaller, lighter and more reliable than the miniaturized electronic news cameras currently available to the TV industry, he added.

Sunlight could propel future spacecraft

An advanced, lightweight, flexible solar array that could produce electricity to propel future spacecraft is shown at right undergoing tests by Lockheed engineers. This 12 x 10ft section was designed and built by Lockheed Missiles and Space Company, Sunnyvale, California, under contract to NASA's Marshall Space Flight Center, Huntsville, Alabama.

The array is designed to be folded and unfolded in space by remote control, depending on energy requirements and the imminent danger of solar flares. A folding mast supports the array as it spirals out of a can in the middle of the solar cell panel.

On future spacecraft, each array could be 12ft wide and up to 100ft long. A pair of such arrays would supply up to 25kW of electricity to a low-thrust ion engine to propel the spacecraft.

NEWS HIGHLIGHTS

Battery cars to be tested in Australia

A shipment of five electric cars has been imported into Australia for the first major tests of battery-electric passenger vehicles in this country.

Mr R. G. Chapman, President of the Australian Electric Vehicle Association, announced recently that the cars had been brought to Australia by several members of the Association. They are the State Electricity Commission of Victoria, Chloride Batteries Australia Limited of Sydney, Australian Mining and Smelting Limited, the Broken Hill Associated Smelters Pty Ltd, and North Broken Hill Limited. The latter three companies are members of the Australian Lead Development Association, which will co-ordinate use of their vehicles throughout Australia.

The newly arrived electric cars are Enfield 8000 Electric City Cars imported from Britain. Although experimental models of the Enfield have been produced for some years, these are from the first major production run of 80 vehicles.

The cars have a maximum speed of 65km/h and a range of up to 90 kilometres without recharging. They are fitted with full ancillary equipment including windscreen wipers and washers, heaters and demisters, and hazard warning lights. Each car carries two adults in comfort, together with room for shopping or small parcels.

The vehicle is powered by eight 12V lead batteries linked in series/parallel configuration to give a 48V system. A separate 12V battery powers lights and accessories. The batteries are recharged via an on-board charger designed to plug into a normal 240V 10A domestic power socket. Both traction and auxiliary batteries are recharged in 8 hours or less.

Mr Chapman said that the first use of electric cars by the average family may come with the purchase of a "city car" similar to the Enfield 8000 for commuter use, local trips, city driving and shopping. A petrol-driven car would probably be retained for long distance journeys.

The electric cars will be displayed at various centres throughout Australia and will be tested under various conditions. The results will be submitted to the manufacturers as part of a world wide evaluation of the cars.

Go-ahead decision for European GEOS program

An important milestone has been reached in the development of GEOS – Europe's latest and most advanced scientific satellite. The development satellite has been successfully completed at BAC's Electronic and Space Systems facility at Bristol and its critical electromagnetic performance has been approved by the European Space Research Organisation (ESRO). This means that work can proceed on flight standard spacecraft.

The go-ahead decision is the culmination of 22 months work by the international STAR consortium team from 14 companies in 10 European countries. Led by British Aircraft Corporation as prime contractor, the consortium is developing GEOS – Europe's first geostationary scientific satellite. – for ESRO.

GEOS, due for launch in the latter half of 1976, will be an important part of Europe's main contribution to the International Magnetospheric Study (IMS) 1976-1978. IMS is a worldwide co-operative programme with the principal objective of achieving a better understanding of the earth's magnetospheric environment.

The satellite will probe regions of the magnetosphere from a synchronous orbit 36,000 km above the Equator, and between the limits of 35° west and 30° east.

The magnetosphere is that volume of space surrounding the earth which is dominated by the geomagnetic field. At the surface and at low altitudes this field approximates to that which might be caused by an imaginary bar magnet embedded in the earth between the north and south magnetic poles, but the field becomes more complex at greater heights, where it is distorted by the solar wind.

The magnetic field on the sun-facing side of the earth is compressed by the solar wind, but on the dark side it is drawn out to form what is known as the magnetotail. The boundary between interplanetary space and the magnetosphere is called the magnetopause. Within the magnetopause there is a complex system of electric and magnetic field which vary in magnitude with the position in space relative to earth and with the degree of solar activity. GEOS will investigate these fields.

Sydney University builds an "ecology house"

The role of electronics in "closed cycle" living

With increasing costs and penalties in our current technology, serious thought is being given to a new life style based on an alternative technology—a technology that is geared to the requirements of nature. This article describes some of the techniques that could be used in creating an alternative technology, and discusses the concept of autonomous living.

by PATRICK HOWDEN*

In recent years, many people have expressed concern about the directions modern technology is taking, particularly in regard to its effect on the natural environment and its wastage of natural resources. According to many conservationists, we cannot continue to consume and waste our natural resources at the present rate for too much longer—at least not without irreparable damage to the environment.

The conservationists do, however, present an alternative technology concept for the future. This new technology calls for the recycling of our natural resources, together with the harvesting of natural energy sources and more efficient utilisation of this energy. And with the increasing costs of fossil fuels and other resources, some of the new concepts are receiving serious scientific attention.

The basic idea behind many conservationists' proposals is to make the individual dwelling as autonomous as possible—an autonomous house if you like. In theory, the autonomous house would be geared directly to nature, providing its inhabitants with most of their day to day requirements.

In order to investigate the degree of autonomy that may be achieved, a group of some 20 students at the University of Sydney are currently engaged in building an autonomous house, or eco-house. Disconnected from public utilities, the eco-house is basically an "ecology scratchpad" where new ideas can be put forward and tested. The ultimate aim of the project?—to demonstrate a possible alternative life style.

Let's take a closer look at the concept of the autonomous house—a concept that the author believes will lead to a new technology that will place minimal demands on the environment.

Basically, an autonomous house is a country or city homestead that is almost completely self-sufficient in organic food, power, water, utilities and garbage disposal—and possibly even for local transport. All waste resources are recycled and on-site resources such as wind and solar power, rain and running water,

*Director, Eco-Tech Workshop, University of Sydney.

Basic Human Needs and Resources on a Per-Capita-Per-Day Basis

	Volume (L)	Solar Area Required (M^2)	Technique Employed	Min. Power Requirements			Windmill Area Reqd. at 10kts ($100W/M^2$)
				kW	kWH	Biogas (M^3)	
Hot Water	16 litres	⅓M^2 heating 11.3M^2 solar still	12.6M^2 roof area for 1 metre annual rainfall	0.027	0.65	0.2 (70% effic.)	0.27
Cold Water	18 litres	—		—	—	—	—
Cooking	—	½M^2	Flat or curved mirror or Fresnel lens	0.3-0.6	0.6	0.25	0.25
Refrigeration	—	—	Solar, methane	—	0.24	0.4	0.1
Light	—	0.2M^2	Solar cells, wind generator, methane	0.06	0.12	0.14	0.05
Food and Fresh Air	—	2.2M^2 for solar heated greenhouse, + additional area for stock, fish, fruit etc, + 20M^2 foliage		—	—	—	—
Methane Digester	36-72 litres	—	Solar heating to 32°C	—	—	—	—
Heating and Air-conditioning	13 litres of water per M^3 room volume	0.13M^2 per M^3 room volume for heating	Several-see text	—	—	—	—.
Transport (1 hour, ⅓ HP)		0.4M^2 solar cells (approx. 30W)	electric bike, methane gas engine	0.25	0.25	0.15 (25% effic.)	0.1
Miscellaneous (pumps, tools, etc.)	—	—	—	—	0.1	0.06	0.04
Total					2kWH	1.2M^3	0.81M^2

plant fuel matter, crops and stock are used carefully and conservatively to create a pleasant alternative life style.

The techniques for achieving these requirements are varied, and may rely to a large extent on the resourcefulness of the individual. For the purposes of this article, however, we will limit our discussion to a generalised view of some of the most important concepts, with emphasis on those topics which are in some way related to electronics. We will start by considering alternative methods of power generation and storage.

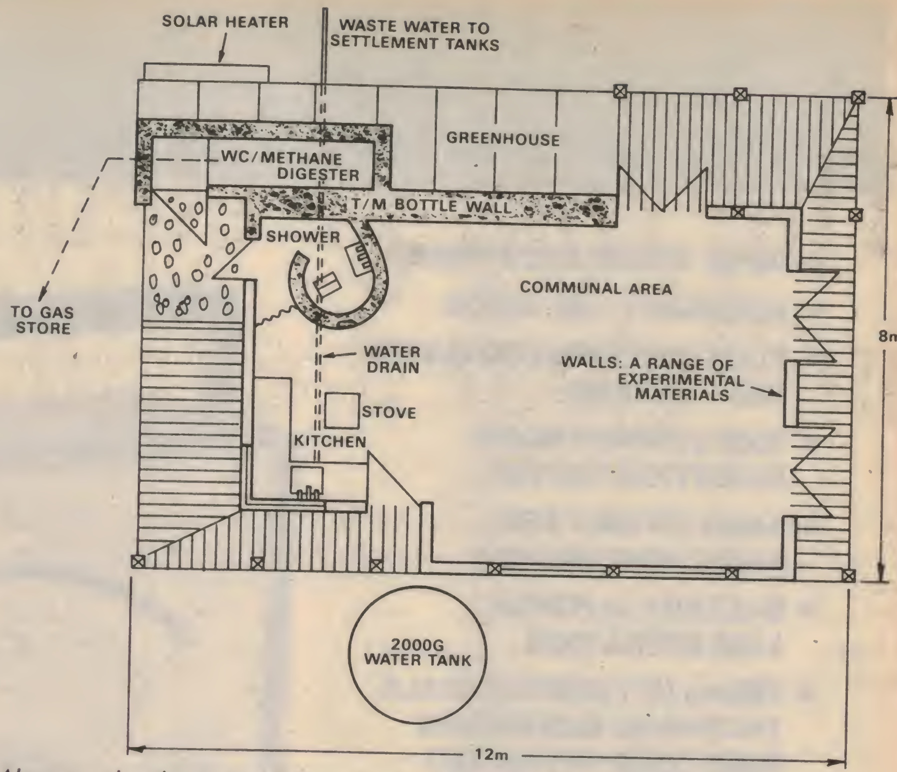
Rich sources of electrical and mechanical energy for the householder are seldom available in nature—at least not for low cost. Probably the most obvious natural energy source to come to mind is the Sun, both for generating heat (hot water, cooking etc) and for generating electricity via solar cells. The latter method is, however, quite expensive, solar cell cost currently running at around $30,000 per kilowatt, or $30 per watt. Further research, aimed at reducing solar cell costs, may bring solar electricity within the means of the average householder in the not too distant future.

Solar heat engines, or Stirling engines, would also cost many thousands of dollars, unless the individual happens to be a resourceful scrounger. The items required here, for example, include mirror reflectors, solar selective surfaces, solar tracking mechanisms, a boiler, a condensor, and the engine.

One of the most likely universal and inexpensive candidates for electric power generation is the wind. The technique employed at Sydney University's eco-house involves the use of a vertical air turbine generator. This technique enables the generator to be placed under the roof of the house, and obviates the need for an external supporting structure. Currently under development is a technique for charging batteries at low charging rates.

Other possible energy systems include wartime suction wood or rubbish gas producers and methane production from sewerage, together with an internal combustion engine and generator set. The exhaust heat or engine coolant may then be used for cooking or to heat water, giving what is termed a "total energy system". Bionic cells, low grade waste heat engines, and pyrolysis or fermentation conversion of rubbish (sewerage) to fuel oils are further sources of energy. Wave and tide generators, and water wheels are also feasible on a small scale.

Methane, stored in a gasometer, and in sufficient quantity can drive cooking, refrigeration and gas mantle lighting facilities. Part of the methane requirement can be met by using a digester to derive the biogas from animal manure, sewerage, kitchen scraps etc. The digester itself must be kept at 32°C, either by solar heat, by burning rubbish, or by burning methane.



Above: a plan drawing of Sydney University's ecology house.

One approach to the latter is to use the exhaust of a methane-fueled internal combustion engine both for digestion heating and for cooking in a total heat system. The engine would have an efficiency of some 25 percent, and could also be used to charge batteries for household power. In addition, mechanical motion would be available for pumps and tools.

Batteries are obviously the most common form of energy storage systems. These are capable of being recharged by any of the above mentioned methods. Radios, television sets, lights, fans, heaters, tools and other appliances can all be built to operate from 12V DC batteries or generators.

For the experimenter, a range of suitable appliances is already in existence and could be adapted to an energy saving environment. For example, most yacht and motor boat lights, pumps and other fittings run from 12V DC batteries, as do car radios, heaters and lights. Two 12V batteries linked in parallel would be ideal, and could be recharged, for example, by an automobile generator driven by a windmill.

Other energy storage systems, some of them quite exotic, have been developed. These include eutectic salt bins for heat storage, thermal batteries, flywheels, compressed or liquified gas, and fuel cells.

Obviously, the success or otherwise of these energy conversion and storage systems is largely dependent on the ways in which energy is used and recycled. In the average household, energy requirements are in the main, related to lighting, cooking, heating, entertainment, and transport. We will examine each of these requirements in turn.

Lighting requirements are probably best met by operating either fluorescent or quartz halogen lamps from a low voltage DC supply, both types being approximately 4 times more efficient than normal incandescent lamps. Note, however, that a 12 to 240V converter is required in the case of fluorescent lamps. Quartz halogen lamps have the advantage in that they may be dimmed readily for further savings in power, although a scattering reflector would be needed for such a point source. Luminescent panels, sewerage derived methane gas mantels, and garbage pyrolysis oil lamps are further lighting concepts.

Low energy electrical cooking can take several options. Since cooking must not consume vast quantities of heat inefficiently, attention is currently focussed on insulated pressure cookers, Renaware and Thermos flask stewing, stored and waste heat methods, and insulated frying pans with built-in electrical heaters. Oddly enough, though, it seems that battery powered 600W microwave ovens are eminently suited here since they have such a low kilowatt hour per meal factor.

Solar energy is another suitable energy source for cooking, this being effected by use of readily available searchlight mirrors, cheap plastic Fresnel lenses, or flat reflectors. However, the problem of solar cooking during the evening becomes one of developing a suitable form of heat storage together with an electrically or mechanically guided solar concentrator. Alternatively, an efficient

rubbish-burning vortex stove, requiring only a few watts to drive a small electric fan, could be used. Such a stove has been designed by the author, and works very efficiently.

Heating requirements are, for the most part, best met by solar energy. Design criteria for solar water heaters are now well established, although such systems are not yet in widespread use. Room heating can be achieved by using electric pumps to circulate solar heated water throughout the building. Additional heating requirements can be met by using excess electrical energy to increase the temperature of a solid (thermal battery), and using a heat coil for subsequent room heating.

Turning now to entertainment, audio and video equipment would rely solely on rechargeable batteries, at least in a completely autonomous situation. Ecology savings in the entertainment area are potentially quite significant. For example, news could be read by selecting any one of 20-odd slow scan TV channels (one per page of newsprint), thus cutting paper requirements and conserving valuable timber resources.

The entertainment centre could even be used to generate additional electricity. For example, one student associated with Sydney University's eco-house suggested that an exercise bicycle could well be hitched to a battery generator or, alternatively, to a mechanical water pump.

For the energy conscious, local transportation is one area that offers considerable potential energy savings. Indeed, with the rising cost of fossil fuels, this area has been the subject of a great deal of research in recent years. Battery operated bicycles and cars, vehicles running on stored heat, gas, or steam, and even man-powered vehicles are all present day concepts for future local transport requirements.

Electronics will obviously play a vital role in the success or otherwise of the autonomous house of the future, particularly in the instrumentation and automation fields. Consider, for example, the methane sewerage and rubbish digester referred to earlier in the article. The requirements for electronic instrumentation in this application include a temperature sensor to keep the digester at 32°C, pH alarm meters to ensure that the mixture does not become too basic or too acidic, an automatic level detector, and possibly a densitometer to detect the percentage concentration of solids.

Other application areas for electronic instrumentation include battery chargers, light dimmers, DC to AC converters, temperature detectors for automatic control of refrigeration and heating requirements, automatic water pollution detectors, and automatic nutrient dispensors and moisture indicators for the solar heated greenhouse, to mention just a few. A degree of automation must be considered essential if the demands of autonomous living are not to become too burdensome.

However, the concept of the autonomous house can be extended beyond a high degree of self-sufficiency in the generation and efficient utilisation of energy, to the sacrifice of those appliances considered non-essential. For instance, windmill driven clothes agitators, hot water bottles and people-powered carpet sweepers are "in", while washing machines, electric blankets and electrically powered carpet cleaners are "out". And who needs an iron if you have drip dry clothes, or a toaster if you have a stainless steel sheet to place on the stove.

Out of all this, one thing is certain—where ecology and energy conservation is concerned, the future is going to be interesting.

Solar water heater manufacturers

New South Wales

Braemar Engineering Co (NSW) Pty Ltd, Bonds Rd, Punchbowl, NSW 2196.

Victoria and Tasmania

Braemar Industries Ltd, 400 Princes Highway, Noble Park, Vic 3174

Queensland

Braemar Engineering Co (Qld) Pty Ltd, Bilsen Rd, Geebung, Qld 4034.

Thermax Electric Water Heaters Pty Ltd, PO Box 173, Hamilton Central, Qld 4007.

Turbon Engineering Pty Ltd, Birubi St, Coorparoo, Qld 4151.

South Australia

Braemar Engineering Co (SA) Pty Ltd, Findon Rd, Kidman Park, SA 5025.

Beasley Industries Pty Ltd, Bolton Ave, Devon Park, SA 5008.

Western Australia

S.W. Hart, 105 Fitzgerald St, Perth, WA 6000.

Smalls Sola Heeta Co, 10 Goongarrie St, Bayswater, WA 6053.

Sola-Ray Appliances, PO Box 75, Tuart Hill, WA 6060.

In addition to the above list of solar water heater manufacturers, readers may also be interested to know that it is possible to purchase wind-driven generators in Australia. These generators are manufactured by Davey Dunlite, a division of Pye Industries. Two models are available—a 1,000W 12-50V model, and a 2,000W 12-110V model. For further details write to Dunlite Electrical Co, 947 Victoria Rd, West Ryde, NSW 2114. Also in Melbourne, Adelaide and Brisbane.

Electronic technology and modern art

An exhibition illustrating the use of computers and electronics in the arts went on show in Canberra recently, with the aim of establishing computer art as a recognised art form. According to those involved, computer art could well serve to ease technological tension in the community, and create a more positive understanding of man's involvement with technology.

Computer technology producing new art forms in film, light, sound, dance and sculpture was the theme of a modern art exhibition held recently at the Lakeside International Hotel in Canberra. Opened by the Prime Minister, Mr Whitlam, on the night of March 7, 1975, the display formed part of the Australia 75 festival, and ran for just over one week.

The show was basically designed as an experiment with audio, video and computer equipment in creating new art forms, the main aim of the display being to bridge the gap between modern technology and art. In all, equipment worth more than $500,000 went on display, and more than 30 people from all over Australia were directly involved in the project.

The display was organised by Douglas Richardson, a research worker who has been pioneering computer graphics at the University of Sydney, assisted by special grants from the Australian Council for the Arts. Richardson saw the project at Australia 75 as an opportunity to present the computer in a more favourable light than that of a monster which carries some sort of threat to a person's humanity, his job, or his privacy.

The problem, Richardson says, is to make people feel at home with computers. Displays of this nature, he hoped, would help ease the access problem, and awaken people to the new possibilities opened up by advancing technology. According to Richardson, many artists would like to use equipment which is now available only to business and scientific establishments. These places would be more willing to help artists once new techniques become established art forms.

The Australia 75 project brought together for the first time Australia's new generation artist/technologists — computer scientists with an interest in new art forms, and artists with an understanding of the potential of computers in creating art. Among those appearing was Stan Ostoja-Kotkowski, an artist who uses modern technology to create highly sophisticated sculptures which respond with sound and colour to the movements of people. Ostoja-Kotkowski termed his display a "reactive environment".

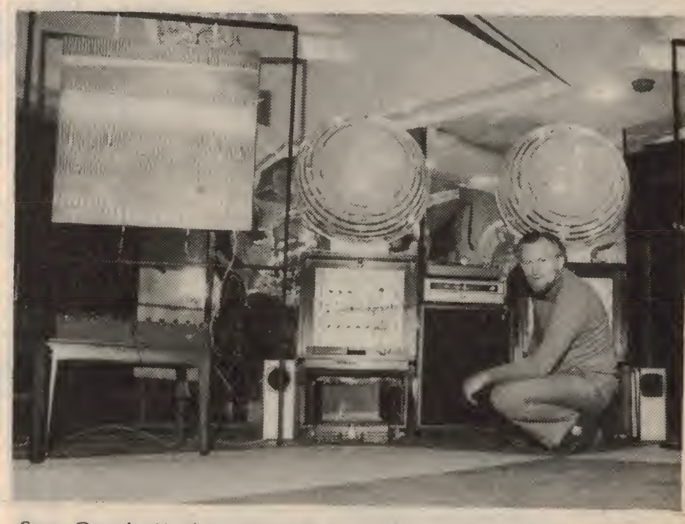
On a slightly different theme, the Department of Engineering Physics at the Australian National University showed a computer-driven colour TV system which produced complex multi-coloured images on a TV screen, together with accompanying computer music. And artist/musician James Penberthy, an Australian composer noted for his computerisation of orchestral music, displayed a system which enabled a string quartet to perform work as it was being composed by a computer.

Festival organiser Doug Richardson used a PDP11 computer to generate motion graphics—a new era of the performing arts he believes is destined to become a popular medium. Computer-aided graphics, says Richardson, may eventually lead to a breakthrough in our very thought processes. No longer will our thinking be confined by our own spoken language.

Other features of the festival included: an exhibition of computer films covering such topics as computer produced art, computer controlled sculpture, and computer choreographed dances; electronic jewellery; music synthesisers; an artists' workshop consisting of experiments, rehearsals, and multi-media jam sessions; and an exhibition showing some of the artistic uses of video technology in Australia.

This article is based on information supplied by courtesy of the "Canberra Times."

Eleven year old Mark Mentzel of Albury Wodonga (left) watches as Phillip Duncan (ANU) operates a computer-driven system to produce complex multi-coloured images on a TV screen.



Stan Ostoja-Kotkowski with his "Theremins and Laser Chromoson" sculptures. The sculptures respond to the movement of people, giving what is described as a "reactive environment."

And now, ladies and gentlemen, we proudly present:

THE INCREDIBLE OPTOMIN!

Here is an imaginative new approach to an old idea. We have dubbed it the "Optomin", and it is played very much like the familiar Theremin. Wave your hands above it, and you can produce all manner of weird and wonderful sounds. Based on light reflection instead of hand capacitance, it offers many advantages over the conventional Theremin.

As you may recall, the Theremin generates audible tones by beating or heterodyning together two radio frequency oscillators. One of these oscillators runs at a fixed frequency, while the other has a frequency which is made variable by the effect of hand capacitance. A third oscillator is often used, with hand capacitance used to control the volume of the final sound.

In an ideal Theremin, both the pitch and volume control effects should be as progressive as possible, with pitch and loudness changing smoothly and linearly with movement of the hands within a fairly large active distance from the respective plates.

Unfortunately, capacitance varies inversely with the distance between hand and plate, so that the closer the hand is to the plate, the greater is the capacitance change for a given small change in distance. This effect is quite difficult to counteract, so that in a practical Theremin, the player must position his hands quite close to the plates, with quite a degree of precision.

A further difficulty encountered with a practical Theremin is the oscillators themselves. Since the frequency of one oscillator must be shifted about 10kHz by hand capacitance, which has a maximum value of the order of 20pF, and since a simple oscillator is required having a minimum of frequency determining components, it is necessary to use LC oscillators operating at about 1MHz. This tends to introduce stability problems.

For details of a practical design for a Theremin, we refer the interested reader to the design published in the June 1969 issue of "Electronics Australia", by Leo Simpson.

Our new design is based on the premise that it should be possible to achieve the same (or similar) effect as a Theremin without the use of the RF oscillators. During a discussion held between several staff members, we conceived the idea of using reflected light as the control medium, instead of capacitance.

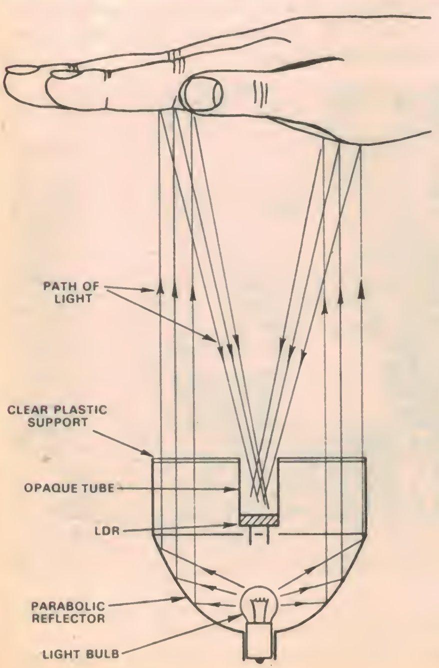


FIG 1

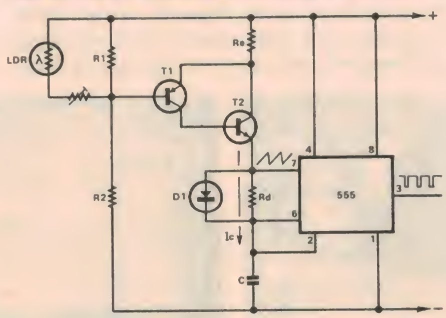


FIG 2

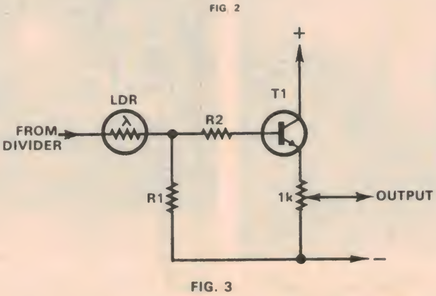


FIG. 3

These three diagrams show the control medium, and how it is used to vary pitch and loudness.

Our idea was to use reflected light from the hand to illuminate a light dependent resistor (LDR). This varying resistance could then be used to change the frequency of an audio oscillator directly. A second LDR, illuminated by light from the remaining hand, could be used to control the output level of the oscillator. Thus was born the basic idea behind our light operated Theremin, or OPTOMIN.

The next step was to see if the idea was practical, and if it could be implemented in a simple and economic way. So we devised a scheme to illuminate an LDR with light reflected from a hand, and examined the resulting characteristic.

Fig. 1 shows the general arrangement of the scheme devised. The LDR is mounted in a suitable sized opaque tube, sealed so that light can only enter from the open top end. This is mounted in a transparent plastic support, and positioned in the centre of a parabolic reflector. Light from the lamp is reflected upwards in a parallel beam. When a hand is placed above the LDR, light is reflected back down into it.

The amount of light reaching the LDR is dependent on the positioning of the hand. More light is reflected as the hand is lowered, until a point is reached where the hand starts to shield the LDR.

In terms of the resistance of the LDR, this means that when the hand is well above the LDR, the resistance is quite high. The actual value will depend on ambient light, but more about this later. As the hand is lowered, the resistance decreases, till the point is reached at which maximum light is being reflected into the tube. The actual minimum resistance will depend on a number of factors, including the reflectivity of the hand and the intensity of the light.

Under actual operating conditions, the practical maximum resistance of the LDR will be about 1 megohm. This will be because of ambient light entering the tube and reaching the LDR. This effect can be minimised by painting the inside of the tube flat black.

Tests on a prototype reflector and LDR assembly showed that a practical configuration could be constructed which gave a resistance change from about 100 k to about 100 ohms. This is a range of 1000 to 1, so that provided suitable control circuits could be designed, we realised that it should be possible to obtain a frequency range extending over the full audio

as demonstrated by its genial inventor, DAVID EDWARDS:

range, and with a large dynamic range.

Initial experiments were conducted using a programmable unijunction transistor (PUT) as a resistance controlled variable oscillator, but these were not successful, as a reliable oscillator with the required sweep range of 1000 to 1 could not be achieved.

We then turned our attention to the ubiquitous 555 timer chip, this time with more success. The basic circuit is shown in Fig. 2.

The 555 is connected as an astable multivibrator, driven by a variable constant current source. T1 and T2 form this source, providing the charge current Ic. The value of this current is set by the amount of bias applied to the base of T1. The voltage divider formed by R1 and R2 is set so that when the LDR has a high resistance, T1/T2 is biased on, and supplies maximum charge current.

As the resistance of the LDR is reduced, the bias on T1 is also reduced, decreasing the charging current Ic. If the LDR resistance is reduced enough, T1/T2 will be cut-off, and no charging current will flow. This can be avoided by placing a suitable resistance in series with the LDR.

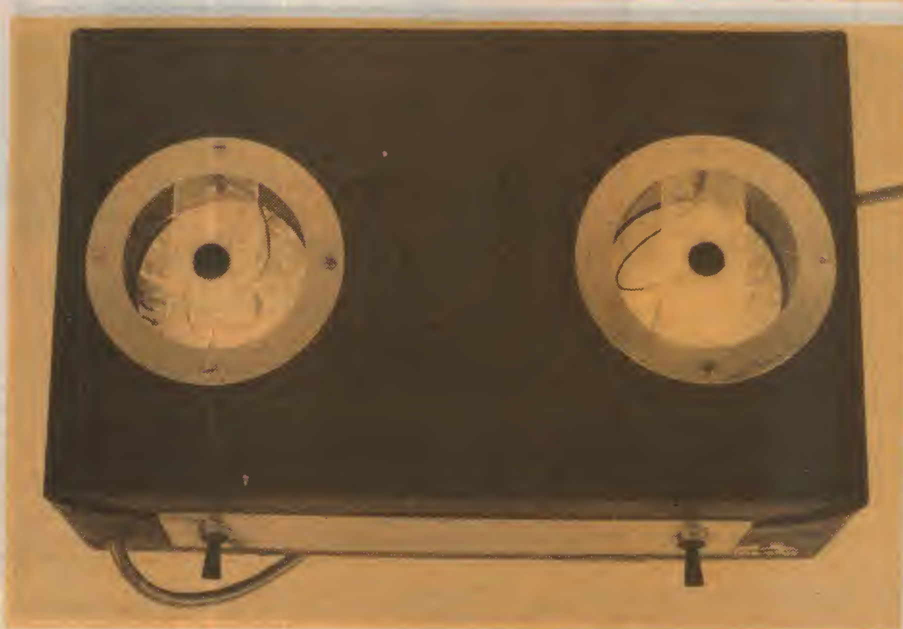
The charging current Ic flows into the timing capacitor C via D1, bypassing the discharge resistor. This means that the on-time of the 555 is determined solely by the LDR and the current generator. When the voltage across the capacitor C reaches two-thirds of the supply voltage, pin 7 is grounded, and C is discharged through Rd, the discharge resistor.

When the voltage has fallen to one-third of the supply voltage, the cycle is repeated again, with C being charged via D1 by Ic. The output signal, obtained at pin 3, is a train of negative going pulses, whose duration depends solely on Rd and C, and whose spacing is set by the LDR and the current generator.

The value of Re is chosen so that when the LDR has a large resistance, and Ic is at a maximum, the charge time is of the same order as the discharge time. This means that the upper frequency of the oscillator can be adjusted by varying Rd. If it is desired to alter the frequency over a greater range than possible by this means, C may be altered.

The lower frequency of the oscillator is adjusted by means of the resistor in series with the LDR, mentioned previously. With this circuit, it was possible to obtain a frequency range in excess of 1000 to 1.

The 555 output is a train of pulses, with a very large variation in spacing. This would not be very good to listen to, as it would consist mainly of high frequencies. To avoid this, we have made the basic oscillator operate be-



Shown above is a player's view of the Optomin. The way in which the reflectors and LDRs are supported can be clearly seen. Note that a different way of wiring the LDRs is recommended.

KITSETS

KIT'S KOLUMN

I don't know if I like this place or not anymore.

Over the last week or so Expense-Account seemed to be displaying singular prowess in ESP and it was getting me a bit rattled.

I mean, he seemed to know the **exact** location of my birthmark and what sort of lace bits I had been wearing and so on, and as there's only one way he could possibly know, I was a bit on edge. (Simply because with **him**, the one way it is a big no-no despite his bags of boiled lollies.)

Then the penny dropped. Or rather crashed to the floor.

The nasty old voyeur had installed one of those closed-circuit TV's in the ladies' room and I would never have found out if it hadn't been for the heavy breathing.

Anyhow, he removed the beast, and since then, we've been having a great time playing with it. You can read more about it at right.

What with that, and all our new stock, we've been run off our feet and things have fallen a bit behind. (Our Ad Agency has suffered 2 heart attacks, 5 new ulcers, and 18 migraines, not to mention some terribly rumpled grey flannel suits.)

Despite falling over our feet, we haven't forgotten to include a real Hi-Fi special this month. All of you who have been drooling over our colour-plan L&G gear, please take note: if you're quick, you will be able to pick up an L&G amplifier at **way** under usual store price. Like the L2600 (30W RMS per ch both into 8 ohms) $199; or L2400 (22W RMS per ch both into 8 ohms) $179. That's all of our promotional stock and when new shipments arrive, prices go back to normal. Yes, we'll take your Bankcard.

Our new Box Hill (Vic.) branch is doing well, thank you. And your letters to me are appreciated. But please, Alfred E. – no more locks of hair. A sacrifice like that makes me embarrassed.

Keep your iron hot — *Kit*

SOLDERLESS ELECTRONIC KITS $3·60 to $17·95

The perfect introduction to electronics. Spring terminals eliminate soldering. All have illustrated instruction manuals. Marvellous as gifts. Our prices are well under you-know-who.

Crystal radio. Really works. No bat required. Complete. P&P 30c. **$3.60**

10 projects in 1: Make radios, TV trouble detector etc. Has solar cell. Takes AA bat. P&P 60c. **$7.40**

20 in 1. Radio, water purity tester, impulse gen. etc. P&P 75c. **$10.25**

65 in 1. Sonic fish caller; burglar alarm, solar cell. P&P $1.50. **$15.40**

80 in 1. Similar 65, but with 20 more experiments. P&P $1. **$16.45**

100 in 1. Has IC, solar bat. relay, Wood case like 65. P&P $1.50. **$17.95**

Attache 150. Suitcase job. Really a portable electronic lab. Makes 150 different projects. Even buffs will drool over this one. Case measures 16" x 8½" x 3½". P&P $1.50. **$30.40**

CLOSED CIRCUIT TV WITH INTERCOM $195

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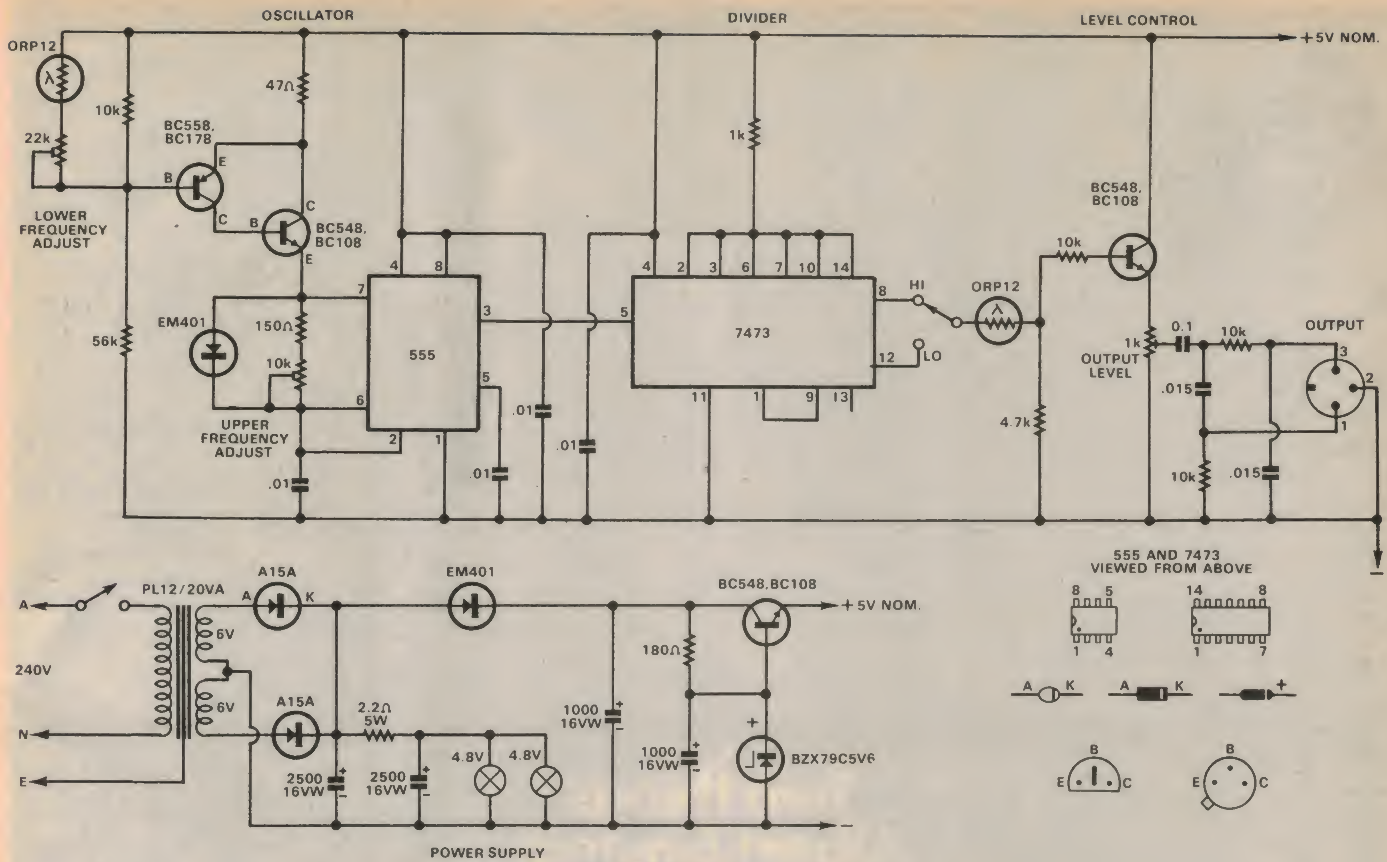

FIG. 4 OPTOMIN (FILE 1/EM/35)

tween 40kHz and 40Hz, and halved the frequency using a TTL flip-flop divider. This gives a squarewave output. The flip-flop selected is the 7473, which is actually a dual flip-flop. The second element is thus available to provide an alternative "low" output.

The volume control stage, used to give a large dynamic range, is rather unusual. Fig. 3 shows the basic idea. When the LDR resistance is large, the base of T1 is held low by R1 and R2, so that T1 is held off, and no output is obtained.

Conversely, when the LDR resistance is low, the flip-flop output signal is coupled to the base of T1, which is then switched on and off. The output signal is taken from the potential divider in the emitter.

When the LDR has an intermediate value of resistance, T1 is only partially turned on, and so the output signal level is not as great. Thus the output signal can be varied from a maximum value to zero, in theory giving an infinite dynamic range.

Having developed a basic design, the next step was to turn this into a practical instrument. One idea which we toyed with for some time was that of including an audio amplifier in the same case as the rest of the equipment. However this would only add to the cost, and we could see no real advantage in it anyway.

Reasoning that most interested readers would own a stereo amplifier, or at least have access to one, we have provided only a standard DIN output connection. This provides a "stereo" signal from the mono one produced by the Optomin, by using two complementary filters—one high pass and one low pass. The 3dB point of both filters is 1kHz.

If desired, these filters may be left out, and the signal fed straight into a mono amplifier. The output signal level is adjustable from about 2V peak-to-peak to a very low level, and should suit most amplifier auxiliary inputs having an input impedance of 50k or more.

Due to the heavy currents drawn by the two lamps, the Optomin is not suited to battery power. The final circuit diagram, Fig. 4, shows the supply we have used.

The electronic sections of the Optomin are supplied with 5V by a simple series regulator using a zener diode and NPN transistor. The two 1000uF electrolytic capacitors act to eliminate any ripple voltages on the 5V line. This is necessary as the oscillator is now quite sensitive to changes in supply voltage.

A dropping resistor is included in series with the two 4.8V lamps, to reduce the voltage supplied to the correct value. This also acts as a filter, in conjunction with the two 2500uF electrolytic capacitors, to prevent any ripple voltages from modulating the light intensity. Final filtering is obtained by the thermal inertia of the lamps themselves.

The remainder of the circuit of the Optomin should be fairly self-explanatory. The only controls provided are two switches, the main power switch and another to select one of the two outputs of the frequency divider. Three preset pots are provided, to adjust for varia-

PARTS LIST FOR THE OPTOMIN

SEMICONDUCTORS
1 555 timer
1 7473 dual J-K flip-flop
1 PNP silicon transistor (BC178, BC558 or similar)
3 NPN silicon transistors (BC108, BC548 or similar)
1 400mW Zener diode (BZX79C5V6 or similar)
2 2A silicon diodes (A15A or similar)
2 1A silicon diodes (EM401 or similar)

RESISTORS (¼W unless stated otherwise)
1 2.2 ohm 5W, 1 47 ohm, 1 150 ohm, 1 180 ohm, 1 1k, 1 4.7k, 4 10k, 1 56k
2 light dependent resistors (ORP12 or similar)
1 1k trimpot
1 10k trimpot
1 22k trimpot

CAPACITORS
4 0.01uF ceramic
2 0.015uF polyester
1 0.1uF polyester
2 1000uF PCB mounting 16VW electrolytics
2 2500uF PCB mounting 16VW electrolytics

MISCELLANEOUS
1 power transformer, 240V to 12V CT, 1.6A (Ferguson PL12/20VA or similar)
1 3 core mains flex, 3 pin plug and cord clamp
1 2 way terminal block
1 case-see text
2 parabolic reflectors—see text
2 4.8V incandescent globes
1 3 pin DIN socket
1 240V single pole single throw switch
1 single pole double throw switch
1 printed circuit board EA 75em6 (81mm x 103mm)
Solder, hook-up wire, machine screws and nuts, circuit board pins, scrap aluminium, shielded cable.

Note: resistor wattage ratings and capacitor voltage ratings are those used in our prototype. Components with higher ratings may generally be used provided they are physically compatible. Components with lower ratings may also be used in some cases, providing ratings are not exceeded.


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tions in components, particularly the LDRs.

The parabolic reflector and lamp support assemblies are provided simply and economically by adapting two Eveready "Commander Lanterns", which retail for just over $2.00.

To modify the lanterns, take off the front cover and disconnect the leads to the lamp assembly. These are push fits into their mating parts. Then unscrew the lamp holder assembly, and extract the lamp. This may be put aside until later. Next undo the bent-over lugs which secure the plastic section of the lamp holder, and remove it. The two metal pieces remaining may be discarded.

Gently prise the reflector assembly from the front cover of the lantern, and extract the clear plastic lens. After modifications, this will become the support for the LDR tube.

You should now have a plastic parabolic reflector, a screw-in bulb holder and a clear plastic lens. The remaining parts of the lantern can be discarded. Repeat this dismantling process for the second lantern.

Two 80mm dia. cardboard tubes each 40mm long are now required. Suitable ones may be obtained from the spools on which copying machine paper is wound. These tubes should be painted flat black inside, and cemented to the tops of the reflectors with an epoxy glue. Refer to Fig. 1 if you are in doubt about their positioning.

A suitable means should be provided for the leads from the LDRs to pass through the walls of these tubes. We used machine screws and nuts, in conjunction with solder lugs, as shown in the photographs. Although we placed ours diametrically opposite to one another, this is not necessary. Probably a better idea is to place them next to one another, so that shielded cable can be used to make connections to the PCB. This is particularly of importance with the LDR controlling the frequency.

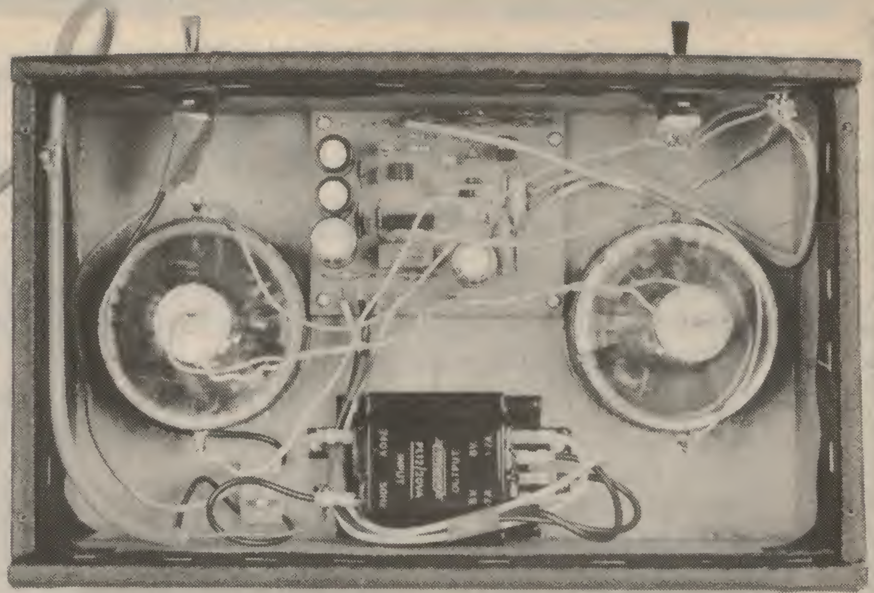
Two 20mm long pieces of 13mm dia. opaque plastic tubing are used as the supports for the LDRs. This type of tubing is used by electricians as "conduit". It will be necessary to file one end of each tube out a little, so that the LDRs are a push fit. When this has been done, paint the inside of each tube flat black (with blackboard paint).

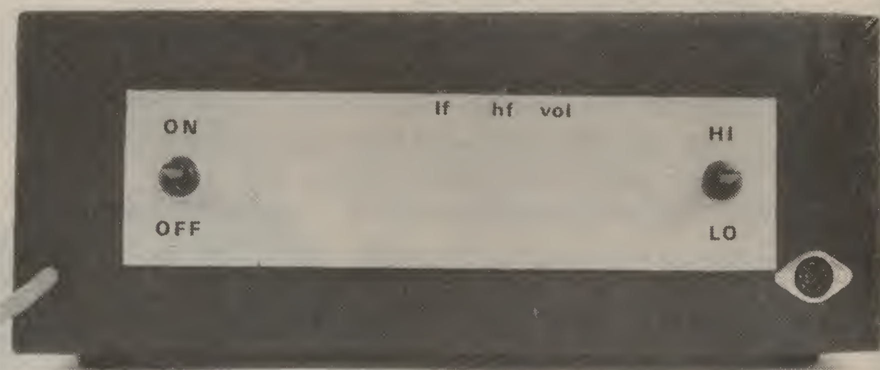
When the paint is dry, fit the LDRs into the tubes, and cement them in with a little epoxy resin. The LDRs should have about 1mm clearance at their lead ends, to allow for the epoxy. After this has dried, the outside and bottom of each tube should be given a sufficient number of coats of white paint to ensure that no light can enter the LDR except down the mouth of the tube.

This is quite important, as otherwise the LDRs will be permanently illuminated by the bulb directly, and the reflected light from your hands will not cause as large a resistance change as is needed for correct operation. We have specified white paint, as otherwise the LDRs will be heated by the light bulbs, and their sensitivity to light will change.

The next step is to prepare the plastic lenses to hold the LDR tubes. As can be seen in the photographs, we have not completely covered the reflector tops with the lenses, as this prevents convection currents from cooling the LDR tubes. For the same reason, there is no covering over the top of these tubes.

The lenses from the lanterns are cut (with a hack-saw or similar tool) into 30mm wide strips, and a circular hole of the same diameter





The top picture shows the layout of components inside the case, while the lower one shows the rear panel. The three holes used to adjust the trimpots can be seen above their respective labels.

as the outside of the LDR tubes is made in the middle. Once this has been done, the LDR tubes can be glued in position with epoxy cement.

Thin hookup wire can now be used to connect between the LDR leads and the inner solder lugs of the cardboard tubes. Before attempting to solder to the LDR leads, make sure that they are clean and free of paint. Then glue these assemblies to the tops of the cardboard tubes, making sure that the LDR tubes are placed directly over the light bulbs.

Having completed the mechanical arrangements for the LDR and reflector assemblies, we can now turn our attention to the electronics section. All components are contained on a single printed circuit board (PCB), measuring 81mm x 103mm, and coded 75em6.

Components are best fitted to the board in a logical procedure, starting with the resistors and capacitors, and finishing with the semiconductors, leaving the IC's till last. When mounting the 2.2 ohm 5 watt resistor, do not forget to leave an air space underneath it, to allow for convection cooling, as it will get quite hot in normal use.

Care is required to ensure that the polarity conscious components, such as the diodes and electrolytic capacitors, are fitted correctly. Refer to the circuit diagram, Fig. 4, for details of the pin markings of these components.

We recommend the use of PCB stakes to make the connections to the off board components such as the LDRs and the lamps, as these give a neater finish, and facilitate later servicing of the PCB.

When the PCB has been completed, a final check should be made to ensure that all components have been fitted correctly in their proper places, and that no solder bridges have been made between adjacent tracks. The time spent in this check is well worth it, as it is surprising how easy it is to make a small mistake which could require much effort to correct.

The final part of the Optomin to be constructed is the case. We have not provided any detailed dimensions of the box which we used, as we felt that most constructors would have their own ideas on the type required anyway. As can be seen from the photographs, all components except the switches and the DIN socket are mounted on the underside of the top of the box.

We made our box from 9mm thick plywood, and covered it with vinyl cloth, held on with staples. With a little care, it is possible to arrange for all the staples to be hidden. The LDR and reflector assemblies are glued into suitable holes in the top of the box, with aluminium rings used to hide the join between the vinyl and the edge of the 80mm dia. tubes.

Do not put the LDR assemblies any closer than about 150mm centre to centre, as otherwise the light from one hand will reach the other LDR, and independent control actions will not be obtained.

Mount the PCB so that the trim pots can

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be adjusted through suitable holes, without dismantling the box. We arranged for all the controls to be on the player's side of the box, with only the name-plate on the front. This is the side that would normally be seen by an audience.

The name plate on the front, and the rear control panel were made from aluminium and pressure sensitive lettering, protected by a layer of clear lacquer. The name plate is fixed to the front of the box with double-sided sticky tape, and the control panel by the two switches.

The wiring between the various component parts should not present any difficulties. Use hookup wire for all connections except those to the frequency controlling LDR, which must have shielded cable. This is to prevent the mains from frequency modulating the output. Shielded wire should also be used for the connections to the DIN socket.

The mains cord is clamped upon entry, with the earth conductor connected directly to a solderlug underneath the transformer mounting screw. This is the only part of the Optomin which is directly earthed, the electronics section being earthed via the DIN connection to the amplifier. This is to eliminate any possible hum loops.

The active and neutral conductors are terminated at a two way terminal block. Use the leads supplied with the transformer to make the connections to the power switch and the transformer.

Now that construction has finished, testing can commence. You will need a small screwdriver to suit the trimpots, an amplifier and speakers, and a pair of tolerant ears. The noises you are about to make are indescribable.

Testing is best carried out in a room with a low ambient light level. In particular, do not place the Optomin directly underneath an overhead light, or allow sunlight to shine on the top surfaces.

First of all, set the trimpots to their mid positions and the HI-LO switch to the HI position, but do not as yet connect up to the amplifier. When the Optomin is switched on, both lights should come on. The supply voltage should be 5V, while the zener voltage should be 5.6V. The voltage across the lamps should be about 4.5V.

Once satisfied that all is correct, switch off and connect up the amplifier. A word of caution is advisable here, as the Optomin is capable of producing large quantities of both high and low frequency sound, which may be detrimental to your amplifier. Until you have gained some familiarity with the Optomin, do not operate your amplifier with bass or treble boost. Do not forget either that the Optomin can produce supersonic sounds, which may annoy dogs!

Set the volume control of the amplifier to a low level, and the bass and treble controls either flat or for a small amount of cut, and then turn on the Optomin. No sound should be produced. Now make an experimental hand-wave over the volume control LDR assembly.

You should be rewarded by some sort of sound, which should vary in intensity as your hand is lowered towards the LDR. Do this slowly, for the sake of your speakers and your eardrums, as quite high levels may be produced. Adjust the volume trimpot so that the maximum level, obtained a few centimeters above the LDR, is within safe limits.

Now hold one hand still over the volume control LDR, and move the other one over the frequency LDR. The frequency of the sound should decrease as your hand is lowered, till you start to block off the LDR tube, when the frequency should start to rise again.

Keeping one hand over the volume control, adjust the high frequency trimpot so that no sound can be heard. This will occur when you exceed the frequency response of your ears. The correct setting of the trimpot is when the sound is just beyond audibility. The actual setting will depend on the ambient light, and may have to be adjusted to suit different conditions. Note that this must be done with the HI-LO switch in the HI position.

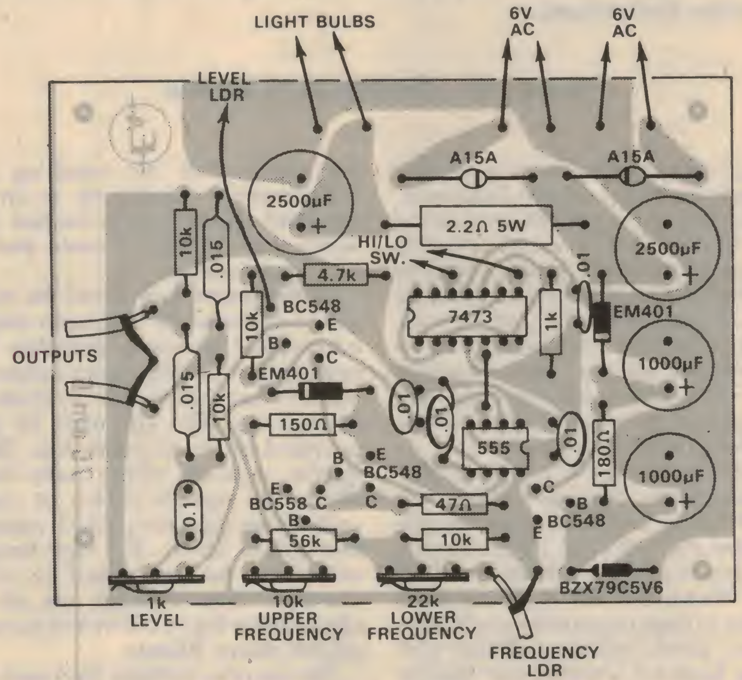
Next, place one hand over the volume control, and your second hand over the frequency control so as to obtain the lowest possible note.

hum to be coupled into the leads to the frequency LDR. This must be eliminated.

If the range of adjustment of the upper frequency trimpot is not sufficient to enable the frequency to be raised above the limits of audibility, then it will be necessary to decrease the value of the 0.01uF capacitor connected between pin 6 of the 555 and earth. The frequency of the oscillator is inversely proportional to this value.

Finally, we will describe briefly the various ways in which the Optomin can be used, and how to play tunes (?) on it.

In general, conventional notes can be produced by moving the pitch hand smoothly up and down, while at the same time moving the level hand quickly back and forth over the appropriate LDR assembly. A fair degree of



The wiring of the printed circuit board should be easy, following the diagram above. Circuit board pins are used to connect between the external wiring and the board. Twelve of these are needed altogether. Note that the board is not shown actual size.

With your third hand (explained in a moment!) adjust the low frequency trimpot so that a suitable note is obtained, ie, one that is not too low. It should only just be possible to hear distinct "PUT PUT" noises.

Readers with only two hands may find this process easier if they use someone else's hand, or alternatively, use their left elbow to control volume, left hand to control frequency, and right hand to make the adjustment.

The Optomin should now be functioning correctly. The volume should be variable between completely off to a value determined by the setting of the trimpot and the amplifier gain, and the frequency should be variable from above audibility down to about 20Hz or so. Before giving details of how to produce the various sounds your instrument is capable of, we will give a short trouble-shooting guide.

If your Optomin fails to operate correctly, the fault is most likely due to a light leak. This can be checked by blocking the top of the LDR tubes. When the volume LDR is blocked, no sound should be heard at all, while when the frequency LDR is blocked, the pitch of the sound should be inaudible.

If the sound produced has a 100Hz frequency wobble, then you have either pointed the Optomin at a light, or you have allowed mains

practice is required to produce effective notes, but the technique can be mastered.

Of course, the Optomin is not intended solely to produce notes of this type, but to produce gliding tones, with no set division into notes. This can be done by simply moving your hands above the LDR assemblies.

You can generate bird calls, sound effects and all manner of other noises, with the appropriate hand movements—and a lot of patience!

Interesting effects can be obtained by placing the Optomin under a light. A tone is then obtained which is frequency modulated at a 100Hz rate. If the instrument is then played in the normal manner, this tone can be used to advantage to produce more effects.

An interesting type of ballet music can be obtained by pointing the Optomin at a window, and then moving about so as to block the light to the LDRs.

Perhaps the most intriguing effects can be obtained by making the Optomin part of a closed loop feedback system. This can be done by using a music controlled light system, such as the Musicolour (December 1971, January 1972, File Nos. 2/PC/15 & 16.). The Optomin is placed in front of the lights, and its output used to control the lights. The results can only be described as weird!

A direct conversion receiver for 3.5MHz

This design for a simple direct conversion receiver has been reprinted from the New Zealand amateur publication, "Break-in". It appealed to us for its simplicity, its quoted performance, and the fact that it provides a simple and inexpensive way to gain experience in direct conversion techniques.

***by B. M. DURDLE ZL2BAM**

This project resulted from a request by several members of my beginners' class last year for a simple receiver to enable them to listen on the amateur bands; both for Morse practice and to give them some idea of correct operating procedures and "jargon". Being a home-brew fan, I felt that it would also be an opportunity to get the class members familiar with construction practice, and also to present the practical applications of the theory side of the course.

The chief requirement for such a project is simplicity: alignment should be possible "by ear" without special equipment, and the need to adjust several tuned circuits to track should be minimised. However, the performance should be at least reasonable and if possible very good. Ideally, it should also form the basis for a transceiver type of unit, to enable the new amateur to get on the air quickly after passing the exam. Capital outlay should be kept down to encourage the younger students.

After thinking about these requirements, I decided that the direct-conversion type receiver would be the best. This type uses all the basic units (oscillators, mixers, RF and AF amplifiers, and bandpass filters) that are met in the superhet and more advanced types of receiver. The performance of direct-conversion receivers is attested to by numerous articles in QST, and Amateur Radio Techniques, as well as elsewhere. Fig. 1 shows the block diagram of the basic unit, while Fig. 2 shows how a CW or DSB transceiver can be made by adding a linear amplifier. This unit can also be used as the basis of a filter type SSB transceiver as shown in Fig. 3. Cost of the receiver is less than $20 (at present prices), buying all components retail.

The principle behind the direct conversion receiver is very simple. A local oscillator signal is mixed with the incoming signal, and the resulting audio component is fed directly to an audio amplifier. Bandwidth is limited in the audio stage to reduce noise and other extraneous nasties.

As the greater portion of the receiver gain is provided by the audio amplifier, a low-noise preamp is desirable. It also enables the low-impedance output of the mixer to be stepped up to a suitable level to feed the filter. The main AF gain is provided by an IC audio unit. The frequency response of the audio block is altered by suitable choice of coupling and bypass capacitors, which restrict the low end to 300Hz. The high frequency roll-off can be determined by use of a low-pass filter, although use of shunt capacitors will give about 6dB per octave roll-off above 3000Hz.

The mixer is perhaps the heart of the direct conversion receiver. One of the major problems with simple direct conversion is that strong neighbourhood signals can pass through the mixer and be rectified in the audio amplifier. Use of a balanced mixer will minimise this problem. By double-balancing, the contribution of oscillator noise can also be considerably reduced. The ring diode mixer with trifilar wound transformers for input and output provides very good balance with no adjustment: however, they provide no gain and need to be preceded by an RF amplifier.

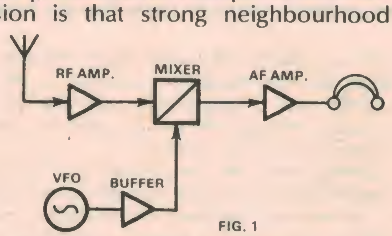


FIG. 1

Fig. 1. Direct conversion receiver.

The oscillator needs to have excellent temperature stability, and should also be able to tolerate the range of voltages to be expected from batteries. A regulated sub-supply should be provided. Generally, a buffer amplifier should be used to provide sufficient drive to the mixer, and to avoid loading changes dependent on signal strength. The circuit should be suitable for both tuneable and crystal-controlled operation. Tuning adjustment should be minimal to avoid setting-up problems.

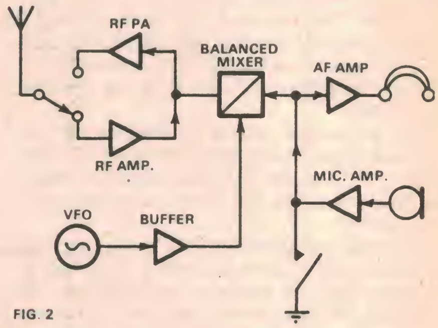


FIG. 2

Fig. 2. Direct conversion transceiver.

The ring diode mixer needs an RF amplifier to provide a degree of gain and some RF selectivity. However, as with all preamplifiers, too much gain can result in cross-modulation problems in the mixer. A gain-controlled stage is best as

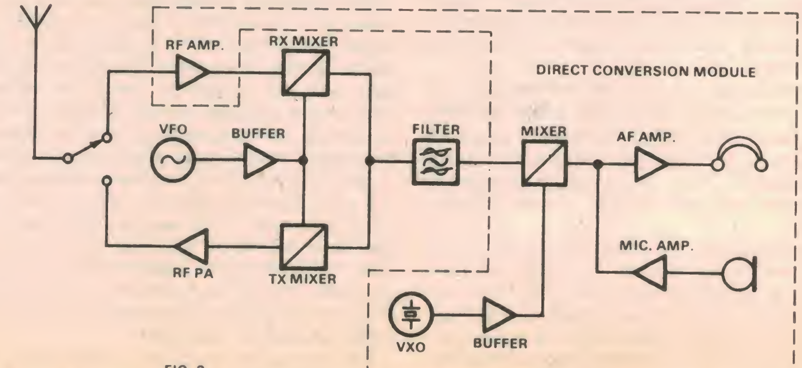


FIG. 3

Fig. 3. The direct conversion module as part of an SSB transceiver.

*5 Oswald Crescent, Newlands, Wellington, New Zealand.

it enables adjustment of preamp operating point to suit the individual conditions. Provision for gain control also permits the use of audio-derived AGC if wanted. As the bandwidth of the receiver is determined by the audio response, a narrow-band filter at RF is not necessary: however, it is desirable to eliminate signals on the second or higher harmonics of the oscillator frequency. A band-pass filter will reject these signals, but minimise tuning problems.

The circuit actually employed is shown in Fig. 4. The input is to a 9:1 broadband

The mixer is a straightforward ring diode type. If ferrite toroids are not available, try to acquire some of the large ferrite slugs with a hexagonal hole right through them: these are more than adequate. Diodes used are the IN914 or equivalent.

The oscillator is a conventional modified Colpitts which has reasonable stability. A 40841 is also used here. The buffer amplifier uses a BC238 in common-collector configuration, and provides about .5 volts to the mixer. No buffer tuning is provided—the ring mixer works

ing. The prototype was mounted inside an ammunition box. These are ideal for QRP gear where no heat problems are anticipated. Being waterproof, they are good for field day or search and rescue use.

An LED can be used for indicating. Provision has been made on the board for it to be wired in series with the dropping resistor to the oscillator zener. If placed in series with the diode, regulation and frequency stability suffer. If not required, it can be replaced with a shorting link.

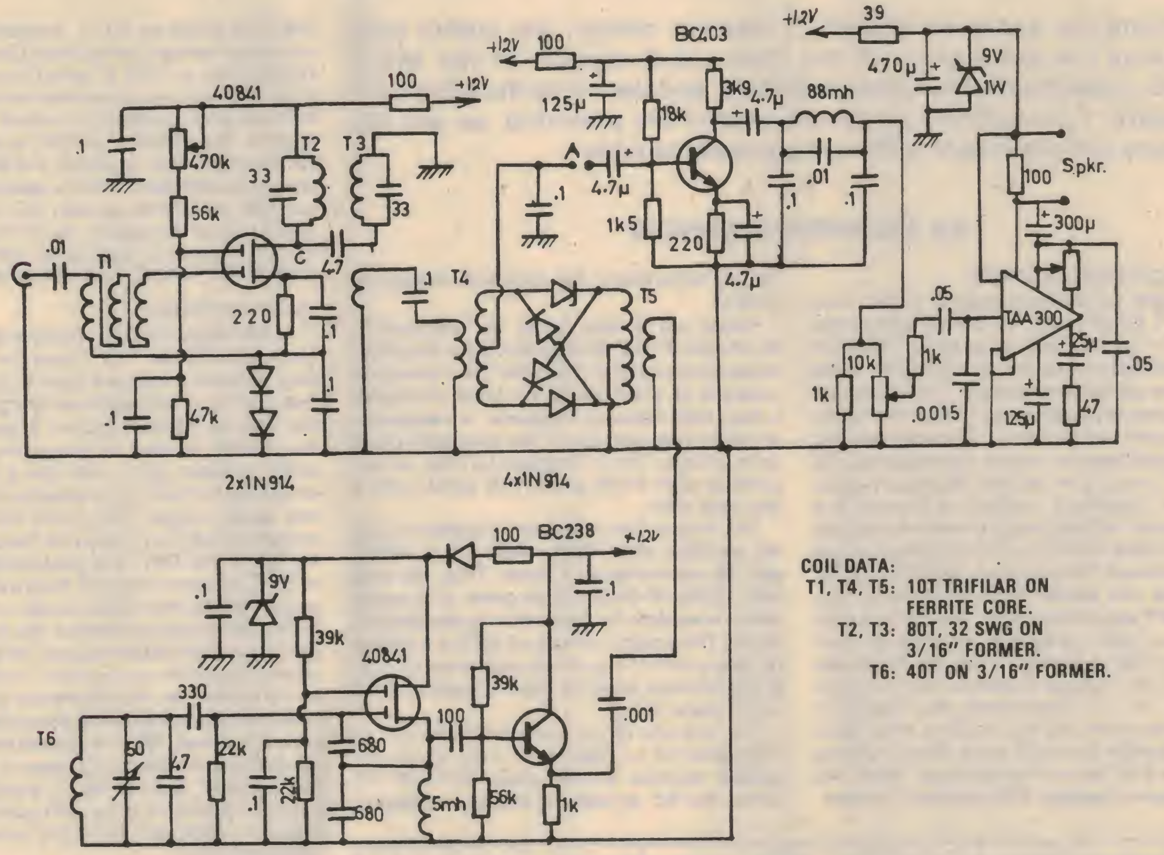


Fig. 4. The complete receiver. Conversion to a transceiver is discussed in the text.

transformer, stepping the 50 ohms of the aerial up to 450 ohms, which just happens to be the optimum noise impedance of the 40841 MOSFET. An untuned aerial will not degrade the receiver sensitivity, but will worsen the noise figure. The RF amplifier is rather novel in that it uses a "dummy earth". The source and gate circuits of the 40841 are returned to a bus held at about 1.5-2 volts above true earth by a diode string. This enables the gain of the amplifier to be varied over about 60dB by adjusting the potential on gate 2, which is nominally at 6 volts. Apart from this, the actual RF stage is very conventional. The RF amplifier feeds a bandpass filter, which was designed to cover the range of 3.5-4 MHz., with a 10k ohm load. With the values actually used, the load is of the order of 9k. Output from the filter is stepped down to about 50 ohms to feed the mixer, using a link winding on the output coil.

best with a square wave input, when it becomes a synchronous switch.

The audio stage uses a BC403 low-noise preamp. To minimise AF detection problems, the bias point of this stage needs to be carefully selected. The main AF amplifier uses the ubiquitous TAA300 IC. Bandwidth is restricted by judicious use of bandpass and coupling capacitors, which leads to a departure from normal values.

Construction on a printed board is strongly recommended. It simplifies construction and operation because lead lengths and component positions are standardised, and strays are therefore all about the same.

Construction of the receiver is straight forward. Coil details are given with the circuit diagram. The main point to note is that the tuning capacitor mounting must be very rigid. In the prototype, this was mounted on an aluminium plate which had its edges folded in for stiffen-

The receiver can be converted into a transceiver by the addition of a single relay and linear amplifier. Application of a DC bias to point A of the mixer output will unbalance the mixer and permit RF to be fed to the bandpass filter. It can be taken off at C to an RF amplifier. Possible operation modes are as follows:

i) CW: Keying can be achieved by applying a DC bias to A. Full break-in operation can be obtained by use of a keying relay which also acts as a T/R switch, and applies a sidetone to the audio amplifier. Shaping of the key pulse can be done using a simple RC circuit.
ii) DSB: Instead of applying a DC potential to point A, the output of a simple microphone amplifier/emitter follower can be used. The RF at point C will then be DSB. This can be transmitted direct, or filtered to produce an SSB signal.

(Continued on page 102)

Design for a PAL-S colour TV receiver — 3

Continuing our series on colour TV receiver design, the author here completes his description of the theoretical aspects of the Mk II decoder, gives brief constructional details, and describes the alignment procedure. Comprehensive specifications are provided, as are the necessary coil details and a DC voltage analysis table.

by ANDREW PIERSON

APC CIRCUIT DESCRIPTION

Averaging the alternate polarity pulses from the ALT-V burst switch by simple integration would be feasible, but in order to maintain effective phase control the varactor diode in the subcarrier oscillator requires a ±2V maximum swing. Since the mark-space ratio of the demodulated burst is fairly low (1:9) a large amount of DC amplification would consequently be required, and this would lead to stability problems. An alternative method of achieving a much greater voltage swing, and which requires only a minimal amount of DC amplification has been employed. This consists of Q33 and Q34 which are two emitter followers driving fundamentally capacitive loads. As the input to Q33 goes 'high', its emitter is forced up, thus charging C62 to 0.65V below the maximum value. As the voltage subsides, C62 remains charged, i.e., it 'remembers' the maximum voltage excursion. As the input to Q34 goes 'low' its emitter is forced down, thus charging C63 to 0.65V above the minimum value. As the voltage increases, C63 remains charged, i.e., it 'remembers' the minimum voltage excursion.

These two voltage levels are averaged by R105 and R106, thus producing a maximum phase error signal of ±500mV from a nominal potential of 7.4V. Since the burst undergoes a four field blanking sequence, a component at frame rate appears in the averaged phase error voltage. This is removed by C64, in conjunction with R105 and R106 which form a low pass filter.

The output from the filter is applied to the DC amplifier stage Q35, which has a voltage gain of approximately 4 times. Thus, the original ±500mV deviation becomes ±2V swing which is suitable for application to the varactor diode. The emitter voltage of Q35 is adjusted by means of RV11 to obtain a potential of +2V at the collector when no input is applied to the ALT-V burst switch.

The cathode of the varactor diode VA1 is maintained at a potential of +4V by the bypassed resistive divider chain R112-R113, whilst the DC amplifier's collector voltage is fed to the anode via R111. As the output phase correction voltage swings from 0V to +4V, the reverse bias on VA1 is varied from 4V to 0V, thus changing its capacitance and so altering the subcarrier oscillator's nominal free-run frequency. The collector of Q35 is bypassed for RF via C65. This prevents 4.43MHz signals being coupled back from the subcarrier oscillator, and so interfering with DC voltage measurements at this point. The time constant of the APC system is determined jointly by C62, C63, R105, R106, C64, R109 and C65.

IDENT RECOVERY

At the output of Q32, positive going pulses correspond to the 135° burst (i.e., the NTSC line). If these pulses are used to reset the flip-flop, the PAL switch will invert the correct ALT-V line and so maintain proper V demodulation. The flip-flop is reset by grounding the appropriate collector (Q37), and this is achieved by arranging for Q36 to be saturated by the positive going pulses. The pulse train from the emitter of Q32 is coupled to the base of Q36 via R114 and C67. The base-emitter junction of Q36, together with C67 form a clamp circuit which ensures that base current can only flow during the positive peaks of the input signal. (R115 is a base return resistor). In this manner, correct operation of the ident recovery circuit is maintained as the saturation control (and hence the amplitude of the demodulated ALT-V signal) is varied. When degraded off-air signals are being processed, this type of clamp performs poorly, and the Mk III circuit reverts to a modified version of the idea used in the first decoder, where each correction pulse is treated independently.

IDENT FLIP-FLOP

Q37 and Q38 are cross-coupled by R117-C68 and R118-C70 to form a bistable multivibrator. The circuit is clocked at line rate by sync pulses supplied from Q7 via the steering diodes D2 and D3 (see section on the sync system). The resulting waveforms at the collectors of Q37 and Q38 are two complementary 7.8125kHz square waves which are used to operate the PAL switch. The ident phase is maintained by Q36 which is saturated during the burst period preceding the NTSC lines. If the ident phase is incorrect when this burst occurs, the collector potential of Q37 will be high. As Q36 saturates the collector potential of Q37 is forced down, thus resetting the flip-flop to the correct state. If the ident phase is correct, the collector potential of Q37 will already be low, and grounding it via Q36 will have no effect.

V (OR PAL) SWITCH

The function of this stage is to invert the relevant demodulated ALT-V lines so that the correct V information is produced. Q39 is a split load dual phase stage, which produces equal amplitude but antiphase versions of the ALT-V signal at its collector and emitter. The mean (DC) levels of these signals are then

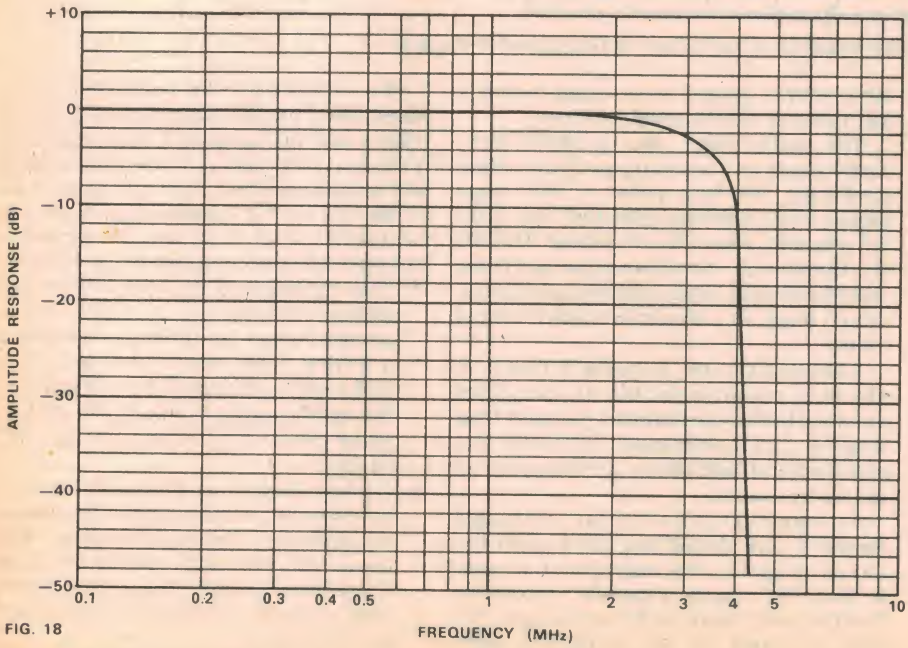


FIG. 18

Fig. 18: Luminance delay line frequency response.

shifted to +6V by means of the resistive voltage dividers R127-R129 and R128-R126-RV12 and the coupling capacitors C74 and C75. Note that whilst the DC level of the signal from the collector is fixed at +6V, the DC level of the signal from the emitter is made variable about +6V by means of RV12. This enables DC balancing of the switch to be achieved.

The path for the collector signal (+6V DC) to the base of Q42 is via R130 and R132. The emitter signal (approximately +6V DC) follows a similar path, through R131 and R133. However, both the junctions of R130-R132 and R131-R133 may be grounded by means of Q40 or Q41 respectively. Since the bases of these transistors are fed by complementary waveform from the ident flip-flop via R125-C76 and R134-C77, only one transistor can be saturated at once, so removing the signal from that path. If for example the signal from the collector is removed by this means, only the signal from the emitter path remains. As the ident flip-flop changes state, this situation is reversed and the output from the switch now comes from the collector path (i.e., the phase is inverted). Because the switching action is controlled by the ident corrected flip-flop, the correct ALT-V lines are inverted and the V signal results. (Actually, it is an inverted V-signal at the junction of R132 and R133, since a phase inversion occurs in the amplifier stage Q43.)

Note that only 1/3 of the signal amplitude present at the collector or emitter of Q39 actually reaches the output of the switch, due to the resistive dividing action which occurs when either Q40 or Q41 is saturated. This and other losses are made up for in the V amplifier stage, Q43. In order to buffer the high impedance output of the switch from the input of Q43, the emitter follower Q42 is employed.

Q43 is an inverting amplifier stage with a voltage gain of 4.5 times. The reconstituted (R-Y) signal appears across its collector load, which is conveniently made the RED AMP. control, RV13. The operating bias for Q43 is chosen so that the no-signal DC collector voltage is approximately 11.5V. This has the effect of limiting the amplitude of a negative-going transient which is generated by the switching process. This appears as a positive-going signal at TP11, and also at the RED OUTPUT socket. It is not displayed because it falls within the horizontal blanking period of the display monitor. This also applies, of course, to the burst demodulation products from all three colour channels. The function of C81 is to limit the HF response of the amplifier stage so that it is not ridiculously in excess of that required to handle the V signal.

(G-Y MATRIX)

Since the luminance signal (Y) is equal to 0.30R + 0.59G + 0.11B, the (G-Y) signal may be reconstituted by adding together in the correct proportions phase reversed versions of the (R-Y) and (B-Y) signals. The correct relationship is expressed by the following formula:

$$(G\text{-}Y) = -0.51(R\text{-}Y) - 0.186(B\text{-}Y)$$

However, the (B-Y) and (R-Y) colour difference signals are subject to weighing factors before encoding. This yields the U and V signals which have the following values:

$$U = 0.493(B\text{-}Y)$$
$$V = 0.877(R\text{-}Y)$$

Since we wish to reconstitute the (G-Y) signal directly from the recovered U and V components, it is necessary to apply these factors to the (G-Y) equation. Practically, the end result is that in order to produce the (G-Y) signal, phase inverted versions of the U and V components must be algebraically added together with a ratio of 1(U):1.54(V).

This addition process is performed by the common collector summing pair Q44-Q45. The addition ratio is set at 1:1.5 by the emitter load resistors R142 and R143. The bias for the U side is derived by DC coupling from the U filter output, but this method is not practicable in the case of the V side, so AC coupling via C82 and the resistive divider chain R140 and R141 has been employed. The (G-Y) signal appears across the common load resistor RV14 which is the GREEN AMP. control.

It should be noted that the necessary level manipulations required to obtain the (B-Y) and (R-Y) signals from the recovered U and V vectors are taken care of by adjusting the BLUE AMP.(RV9) and RED AMP. (RV13) controls during the set-up process. This also applies to the output from the (G-Y) matrix, where the GREEN AMP. (RV14) control is adjusted until the (G-Y) equation is satisfied.

DERIVATION OF THE R, G AND B SIGNALS

The recovered (R-Y), (B-Y) and (G-Y) colour difference signals may be converted to the red, blue and green signals necessary to feed their respective guns in the tricolour kinescope by simply adding the luminance signal. This cancels the (-Y) component in the colour difference expression, leaving only the original primary colour component. However, since the colour difference signal is limited in bandwidth to less than 880kHz and the luminance signal has full bandwidth, the cancellation takes place only for frequencies below 880kHz. Above 880kHz, the high bandwidth luminance signal appears equally in all three channels. The result of this action is that the picture is displayed in black and white for bandwidths above 880kHz, whereas below this limit the larger areas which would normally be white or grey are replaced by coloured areas of the correct hue and saturation.

LUMINANCE DELAY LINE

As we have seen, the colour information is restricted to the frequency spectrum below 880kHz, whilst the luminance channel maintains full bandwidth (0-4.3MHz). The limited rise time of the chrominance channel will result in the decoded colour difference signals being displayed after their Y-signal counterparts. Since the scanning beams traverse the face of the CRT in about 52uS (the active picture period), any time delays between chrominance and luminance channels will result in a positional displacement between the two displayed signals. The visual effect of this is that the coloured areas appear slightly to the right of where they should be (with respect to the black and white Y signal). This effect is corrected by delaying the Y signal for a period of time equal to the delay suffered in the chrominance channel by virtue of its restricted bandwidth. In practice, the amount of delay employed is around 600-700nS and is brought about by passing the luminance information through a wide-band delay line.

Luminance delay lines for colour television use are generally of the distributed constant type, where the inductance is wound as a single layer solenoid over a metal foil covered former. The foil is wound either as a helix or in individual strips so that eddy current losses are not introduced by shorted turns. The distributed capacity appears between the turns of the winding and the metal foil which is earthed. There may also be several short isolated patches of foil on the outside of the coil. These act as small high-pass bridging capacitors, and serve to correct the high frequency response of the line.

Delay lines of the type just described are ideally suited for high volume manufacture, but

SPECIFICATIONS

1. EXTERNAL CHARACTERISTICS

1.1 Input signal requirements
- 1.1.1 Nominal 1 V p-p, PAL encoded with the following amplitudes: video 700mV, sync 300mV, burst 300mV p-p.
- 1.1.2 Minimum burst amplitude permissible prior to setting up: 100mV p-p (—10dB from nominal)
- 1.1.3 Signal level variations permissible during operation: Luminance and sync component: +6dB, —6 dB; Chroma component: +6dB, —8dB
- 1.1.4 Input impedance: 200 Ω (approx. minimum)

1.2 Output signals
- 1.2.1 RGB levels:
  - RED: 1 V p-p composite video plus red picture component
  - GREEN: 1 V p-p composite video plus green picture component
  - BLUE: 1 V p-p composite video plus blue picture component
- 1.2.2 RGB output impedance: 100 ohm all three channels
- 1.2.3 Vector levels:
  - U: —100mV on demodulated bursts
  - ALT-V: +100mV and —100mV on demodulated bursts
  - V: +100mV on demodulated bursts
- 1.2.4 Vector output impedance: U: 180 ohms; ALT-V 180 ohms; V: 1 k.

1.3 Power supply requirements
- 1.3.1 Nominal supply voltage: +12V
- 1.3.2 Permissible supply voltage variation: ±100mV (studio); ±500mV (domestic)
- 1.3.3 Maximum supply rail ripple and noise permissible: 5mV p-p
- 1.3.4 Nominal supply current: 380mA (V supply = +12V)

2. INTERNAL CHARACTERISTICS

2.1 Decoding system: PAL-S

2.2 Demodulation axes
- 2.2.1 U: 0°
- 2.2.2 V: 90° Subcarrier drive not phase switched, thus yielding ALT-V. V reconstituted by post-demodulation PAL switching.

2.3 Ident correction: Automatic, on NTSC (burst = 135°) lines

2.4 (G-Y) matrix ratio 1(U) : 1.5(V)

2.5 Chrominance bandwidths
- 2.5.1 Chroma separation stage: 1.6MHz (—6dB)
- 2.5.2 fc of demodulator filters: U 880 kHz (ALT-V 880 kHz)

2.6 Luminance delay line
- 2.6.1 Delay period: 700nS
- 2.6.2 Bandwidth: 3.6MHz (—6dB)
  4.3MHz (—48dB)

PAL-S COLOUR TV RECEIVER

because of present supply difficulties, a 'lumped constant' delay line has been synthesized from 33uH video peaking chokes and 150pF capacitors. Since this delay line consists of ten cascaded series L and shunt C stages, each section forms a low pass filter. Knowing the minimum cut-off frequency required (i.e., the transition point between the pass band and the attenuation band), the maximum time delay available per section may be calculated; since

$$fc = \frac{1}{\pi\ td}$$

where fc = the cut-off frequency in Hz,
and td = the time delay in seconds.

If we consider 4.5MHz as an acceptable figure for fc, then by applying the above formula we see that the maximum delay per section is approximately 70nS. If a total delay of 700nS must be produced, ten sections will be required. According to the image parameter theory, they may be cascaded, one after another, whilst retaining a total fc the same as for a single section.

The next relevant formula is the relationship between time delay and the L-C product.

$$td = \sqrt{LC} \text{ seconds,}$$

where td = the time delay in seconds,
L = the series inductance (per section) in henries,
and C = the shunt capacitance (per section) in farads.

Since the delay per section is fixed at 70nS and we have selected a value of inductance (33uH), the required value of capacitance to produce the desired time delay may be calculated. In this case it is 150pF.

If the delay line is to produce a signal free from reflections, it must be driven from a source having an internal impedance equal to the characteristic impedance of the line. The output end of the delay line must also be terminated by an impedance again equal to the characteristic impedance of the line. Now,

$$Zo = \sqrt{\frac{L}{C}}$$

where Zo = the characteristic impedance in ohms,
L = the series inductance (per section) in henries,
and C = the shunt capacitance (per section) in farads.

For the delay line used in this circuit, the characteristic impedance is 470 ohms. If the line is sourced from, and terminated by, this impedance the resulting picture shows no evidence of ringing or other defects. The use of m-derived driving and terminating sections has been found to be unnecessary.

Referring to the circuit diagram, the lumped inductances are L7-L16 and the lumped capitances are C84-C93. Since the luminance delay line is driven from a low impedance source, the series resistor R144 is necessary to present the correct source impedance to the line. The terminating resistor is R145. It can be be seen that the luminance signal suffers a 6dB loss with this arrangement, but this is made up in the subsequent addition and output stages.

ALTERNATIVE DELAY LINE

If only a small screen receiver is contemplated, the shadow mask or aperture grille in the CRT may limit the overall resolution obtainable. Consequently, a more economical delay line may be used, and the following data is for a 5-section line which I used in early experiments.

td (per section)	= 125nS
td (total)	= 625nS
fc	= 2.5MHz
L	= 33uH
C	= 470pF
Zo	= 270 ohms

This line may be directly substituted for the 10-section type specified, providing that the source and terminating resistors (R144 and R145) are changed to 270 ohms.

LUMINANCE ADDERS

Addition of the delayed luminance signal and the demodulated colour difference signals is a simple algebraic function, and takes place in the common collector summing pairs Q46-Q47 (BLUE), Q49-Q50 (RED) and Q52-Q53 (GREEN). Only the (B-Y) and Y summation will be described, as the operation of the other two additions is identical.

Q46 is the luminance side of the blue adding pair. The gain is fixed at 6dB by the ratio of the collector load (R153) to the emitter load (R152), and the purpose of this is to compensate for the 6dB termination loss of the luminance delay line. Operating bias is provided by the resistive divider R146-R147 via R148, and is applied to the bases of all three luminance adders in parallel. The signal from the delay line is coupled to all three stages via C95.

DECODER

Q47 is the colour difference side of the blue adding pair. The gain is fixed at 11dB by the ratio of the collector load (R153) to the emitter load (R154). Operating bias is supplied from the resistive potential divider R149-R150 via R151, and the (B-Y) colour difference signal is AC coupled to the base of Q47 via C94.

OUTPUT STAGES

When the design of these stages was being considered, thought had to be given to the requirements of the experimenter. In a domestic colour receiver, access to the recovered colour signals is normally not required, so the signal paths progress from the decoder outputs to the CRT via a minimum of components. However, for studio and professional use it is customary to distinctly separate the functions of the decoder and display devices. To enable interconnection between pieces of equipment of diverse manufacture, standards have been set. The method adopted for transfer of video information is via 75 ohm coaxial cable. The signal amplitude is 1V p-p, with video 700mV positive-going and sync 300mV negative-going. Since coaxial cable is a transmission line, it is necessary to terminate the line at the receiving end with a resistance equal to the cable's characteristic impedance, i.e., 75 ohms. Under these circumstances, an emitter follower is usually employed to drive the line at the sending end. This is not absolutely necessary, and various compromises may be made in the interests of economy.

Since three coaxial line driver stages would have to be provided, their inclusion would result in a considerable increase in the overall component count. To avoid this, the compromise stages Q48, Q51 and Q54 have been used. The cables are driven from a 100 ohm source impedance which is the collector load for a common-emitter amplifier stage. The cables cannot be terminated since this would reduce the gain of the stage, but at least 5 metres of unterminated 75 ohm cable can be driven

without the introduction of high frequency deterioration or ringing. This drive capability should be more than adequate for the average experimenter, whilst still maintaining an economical output stage.

All three line driver stages are identical, and each consists of a PNP amplifier stage which is DC coupled to the common collector point of the colour difference and Y summing pairs. The bias conditions for the summing transistors are such that the quiescent potential at the collector of each line driver stage is approximately 2.1V. In order to offset losses, the stages have a slight gain (1.6dB) and are designed to drive video amplifiers with input impedances of 1k and upwards. The output coupling capacitors are C97 (BLUE), C100 (RED) and C103 (GREEN). Note that the gains imparted to the luminance signal in each colour channel are both fixed and equal, thus simplifying the task of colour balancing the display monitor. With the saturation control turned fully anticlockwise, the blue, red and green gains of the video amplifiers associated with the CRT are adjusted to produce a black and white picture with truly white highlights.

The output from the luminance delay line is 48dB down at 4.3MHz. Since this figure is considerably below the subcarrier frequency, most of the colour difference sidebands are removed. In this manner, fine patterning in the luminance channel from the colour information is avoided.

RGB OUTPUT

When a colour signal is transferred to a display monitor as three discrete red, green and blue video signals, the process is known as RGB transfer. Standard colour monitors accept a composite sync waveform from the GREEN channel, or from an external source. It is not necessary that sync waveforms be added to the red and blue signals, so they normally carry only composite blanking information. In the case of this RGB output circuit, it is simpler to leave the sync information on all three channels, since they naturally acquire it from the added luminance signal.

COLOUR DIFFERENCE OUTPUT

The RGB colour output configuration which has been employed in this decoder is now almost universal, especially since the advent of integrated circuits which have considerably reduced the complexity (as far as the external component count is concerned) of the luminance adding circuitry. However, mention should be made of an alternative colour output format which has been used in the past, in the interests of economy. This is known as COLOUR DIFFERENCE output, and uses the display CRT to perform the luminance adding function. The (R-Y), (G-Y) and (B-Y) colour difference signals are fed to their respective control grids, and a phase-inverted version of the delayed signal is supplied to all three cathodes which are connected in parallel (or vice versa). Although four video amplifiers were required (one with wide bandwidth for the luminance signal and three with narrow bandwidths for the colour difference signals), the result was a considerable reduction in overall component count. This was of considerable importance in valve receivers, but for experimental use it is very restrictive because electrical signals corresponding to the wide-band red, green and blue components of the picture are not available at any point in the receiver. Also, it is not possible to drive another colour monitor from the decoder output, or to feed the receiver's display from an RGB signal source.

MONITORS

At this point it may be useful to define the term 'monitor'. This is generally applied to television display devices which have the ability to produce either a black and white or colour picture from a standard 1Vp-p composite video signal supplied via a 75 ohm coaxial cable. A simple monitor will perform only this function, but more sophisticated types have facilities which enable them to be synchronized from an external source. A colour monitor may have an inbuilt decoder, so that signals with either an RGB or encoded format may be displayed.

OUTPUT SIGNAL COMPATIBILITY

Although the red, green and blue outputs from the decoding system differ from the industry standard in several minor ways, they should drive most commercial monitors without trouble, providing that the cable terminating limitations are borne in mind. Since the demodulated burst is not removed from the three outputs, the monitor's video amplifier clamp circuits must be of a type which is not affected by the presence of this information.

It should also be noted that in this colour recovery system, the chroma channel is not gated 'off' during the picture blanking periods. For clean signals this does not matter, but when noise is present on the demodulated colour difference signals, it is subsequently added to the luminance signal. Since this noise is also present on the back porch, it can cause variations in the clamping potential when is is applied to a colour monitor. Because the noise components will be different for each colour channel, the clamping potentials for the three electron beams can vary, even though the same picture line is being displayed. The visual effect of this is for odd lines to be tinted in either an additive or a subtractive colour. Because the noise components are constantly changing, the resultant pattern is particularly annoying. In the Mk III circuit, yet to be described, the chroma channel is blanked off during the sync pulse and breezeway periods,. so that an accurate clamping level is maintained under noisy conditions.

One may wonder why the RGB output unit was not designed to deliver a standard RBG format signal in the first place. The answer is that the extra circuitry to do this would be considerable, and that since most experimenters would not have access to commercial colour television equipment, the extra expense would not be justified in the majority of cases. However, it is also true that a significant percentage of experimenters would be employed in the television industry, and having access to high grade equipment, would like to be able to evaluate their decoder or monitor against known standards. For this reason a measure of compatibility was desirable, and I think that the required compromise has been reached.

CONSTRUCTION

Although most interest will be centred on the Mk III circuit, some constructional details and information on components will now be given for those interested in the Mk II system. If you are preparing printed circuit cards or hard wiring the unit, try to keep the subcarrier oscillator section as far away as possible from the chroma separation circuitry, in order to minimise the possiblity of 4.43MHz pickup. Another important point concerns supply rail bypassing. This problem has been solved quite successfully by distributing a number of 10uF low inductance tantalum 'tag' electrolytics throughout the circuitry, with each capacitor being strategically placed. Please note that the positioning of individual rail bypasses is important, and they should be fitted exactly where indicated on the circuit diagram.

COMPONENT TYPES

It will be seen from the circuit diagram that only three types of transistors and diodes have been used. The type numbers specified are those which would be most commonly known, but they may not necessarily be the cheapest. Any of the listed substitutes may be used.

The BC109 may be replaced by the following types: BC184L, BC109B, BC109C, BC209, BC209B, BC209C, BC208A, BC208B, BC208C. The 2N3638A may be replaced by either the MPS3638A or PN3638A. An MPF102 may be substituted for the 2N3819, but the lead connections are different. The 1N914 may be replaced by any reasonable speed silicon diode, and suitable alternative types would be the 1N914A, 1N4148 and AN2003.

All capacitors associated with tuned circuits and timing or phasing networks should be

DC VOLTAGE ANALYSIS

MEASUREMENT CONDITIONS:

1. No signal input.
2. Oscillator stopped, by backing off RV5 or removing C25.
3. Measuring instrument impedance 10M or greater.
4. All figures quoted are in VOLTS.

Q1: B 1.08, E 0.52, C 6.61
Q2: B 0.95, E 0.36, C 7.63
Q3: B 7.63, E 8.22, C (burst gate shut) 0.05, C (burst gate open) 2.89
Q2-Q3 decoupling point (junction R10 and C5): 11.02
Q4: B 2.70, E 2.11, C 9.73
Q5: B 10.93, E 11.58, C 2.16
Q6,Q7,Q8,Q9: pulsed operation

Q10: Burst gate shut	Burst gate open
B 0.05	B 2.89
E 0.00	E 2.26
C 12.00	C 6.10

Wiper of RV3: 5.34*
Q11: D 12.00, S 5.83*
Q12: B 5.83*, E 5.20*, C 11.29*
Q13: B 11.29*, E 11.91*, C 0.81*
*Indicates wide variations possible between individual circuits. Affected by spreads of Idss parameter in Q11, and also activity of Y1.
Q14: B 1.08, E 0.44, C 6.53
Q15: B 6.53, E 3.63, C 7.21
Q14-Q15 decoupling point (junction R42 and C26): 10.78
Q16: B 8.11, E 7.51, C 12.00
Q17: B 8.22, E 8.84, C 0.62
Q18: B 10.48, E 11.14, C 3.76
Q19,Q23: B 3.00, E 2.46, C 9.54
Q20,Q24: B 3.76, E 3.11, C 10.50
Q21,Q25: B 0.72, E 0.14, C 11.86
Q22,Q26: B 2.19, E 1.55, C 8.20
Q27: B 1.19, E 0.60, C 5.94
Q28: B 2.68, E 2.07, C 12.00
Q29: pulsed operation
Q30 (switch 'on'): B 2.07, E 1.57, C 8.62
Q31: pulsed operation
Q32: B 8.62, E 7.96, C12.00
Q33: B 7.96, E 7.52, C = 12.00
Q34: B 7.96, E 7.25, C = 0.00
Junction R105-R106: 7.38
Q35: B 7.38, E 8.90, C 2.00
Q36,Q37,Q38: pulsed operation
Q39: B 3.80, E 3.15; C 8.85
Q40,Q41: pulsed operation
Q42: B 1.96, E 1.40, C 10.60
Q43: B 0.70, E 0.10, C 11.53
Q44: B1.63, E 1.01 C 10.41
Q45: B 1.55, E 0.89, C 10.41
Q46,Q49,Q52: B 1.36, E 0.74, C 9.61
Q47,Q49,Q52: B 1.36, E 0.74, C 9.61
Q47,Q50,Q53: B 0.87, E 0.25, C 9.61
Q48,Q51,Q54: B 9.61, E 10.25, C 2.13

polystyrene or mica dielectric types. Since C21 forms part of the oscillator's tuning capacitance, it should be an NPO ceramic type. For the R-C LP filter networks and all 150pF 'speed-up' pulse coupling capacitors, conventional ceramic dielectrics with temperature coefficients of up to N750 ppm/°C may be used. These types will also be sufficiently stable for the lumped capacitances associated with the luminance delay line (C84-C93).

All the 1nF and 10nF values should be plastic film greencaps, or similar. All the 1uF and 10uF values should be tantalum 'tag' electrolytics. Most of the 10uF capacitors are being used for bypassing where the low inductance characteristics of the 'tag' construction are absolutely essential. The largest value of capacitor required is 100uF, and these should be conventional aluminium foil electrolytics.

All resistors are ¼W, 5%, tolerance (unless marked ½W). All potentiometers are linear curve, 200mW dissipation types (Piher PT10V, or similar). D1 is a type BZX79/C4V7. Y1 is a quartz crystal, 4.433619MHz (Bright Star type D30PF or equivalent), and will require a style 'D' socket to suit. CV1 is a film dielectric trimmer, 5.5-65pF Philips type 2222-808-01001 or equivalent).

With the exception of the crystal, all parts for the circuit just described should be available from any comprehensive components supplier.

ALIGNMENT PROCEDURE

1. Before commencing alignment, set the following potentiometers fully anticlockwise: RV1 (Chroma Gain), RV5 (Osc. Amp), RV6 (Saturation), RV9 (Blue Amp), RV13 (Red Amp), RV14 (Green Amp).
2. Set the following controls to their mid position: CV1 (Tune Crystal), RV2 (Burst Period), RV3 (Set Burst Clip), RV4 (Osc. Inj. Amp), RV7 (Alt-V 0), RV8 (U 0), RV10 (Switch Set-up), RV11 (DC Amp. Set-up), RV12 (Switch DC BAL).
3. Set the slug of TR1 so that it lies half out of the secondary winding on the primary winding side.
4. Set the slug of L2 so that it lies half out of the winding.
5. Apply +12V to the system, and check that the current drawn from the supply is normal (i.e. approximately 380 mA).
6. Apply a 1V p-p PAL encoded video signal to the input of the decoder. This should preferably be a standard colour bar signal, but ordinary commercial program material will do.
7. Trigger or synchronize your CRO from the composite line sync waveform available at TP3.
8. Observe the chroma output at TP1. Alternately, advance the CHROMA GAIN potentiometer (RV1) and tune the slug of TR1 so that the burst amplitude is maximum (adjust slug of TR1) and also 1Vp-p (adjust RV1). Note that TR1 will tune with the slug in two places, and that the correct position is when the slug is situated on the primary winding side, i.e., the position which gives maximum coupling. The resulting waveform at TP1 can be seen in Fig. 3.
9. Observe the burst gate output at TP2. Adjust RV2 so that the burst gate period is 3.6uS. Alternately, adjust RV2 so that the burst gate closes just after the burst has finished (see Fig. 4).
10. Observe the waveform at TP4. Adjust RV3 so that the burst is not clipped off. Now tune CV1 for maximum ring amplitude at TP4.
11. Adjust RV4 so that the ring amplitude at TP4 is 500mV p-p. Now adjust RV3 so that the burst is clipped off, and the 500mV p-p ring signal sits on a pedestal of 1.5V (see Fig. 5).
12. Observe the ALT-V burst switch output at TP8. Adjust RV10 so that the nominal 8.6V level does not change during the burst period.
13. With a DC coupled CRO, VTVM or high input impedance voltmeter, adjust RV11 so that the DC potential at TP9 is 2V.
14. Observe the oscillator output at TP5, and advance RV5 until oscillations commence. The oscillator will probably be off-lock (evidenced by beat products at TP5), but increase the oscillator amplitude to approximately 5V p-p. Now adjust the slug of L2 so that the frequency of the beat patterns at TP5 decrease to zero, where the oscillator will 'snap' into lock. RV5 should be adjusted during this procedure so that the output amplitude is maintained at 5V p-p.
15. Observe the ALT-V vector output at TP6. Advance the SATURATION control (RV6), and demodulated ALT-V signal should appear. Adjust RV6 so that the demodulated burst is approximately +100mV on one line, and —100mV on the next, i.e. 200mV p-p. If the swings are unequal, the oscillator is near the edge of its locking range, and the slug of L2 should be adjusted so that the demodulated ALT-V waveform is symmetrical.
16. Readjust RV11 to give 2V DC at TP9. The oscillator will now probably be off-lock.
17. Readjust the slug of L2 for symmetrical ALT-V demodulation at TP6.
18. Readjust RV6 to give an ALT-V burst demodulation of exactly 200mV p-p.
19. Check that the potential at TP9 is between 1.8V and 2.2V. If this is not so, repeat steps (16) to (19).
20. Note whether symmetrical ALT-V demodulation is achieved at the centre of the oscillator's locking range. If this is not so, the ALT-V phasing control (RV7) may be adjusted to bring about this condition. If a movement of RV7 has been necessary, ensure that the voltage at TP9 is still 1.8V-2.2V with symmetrical ALT-V demodulation. If not, repeat steps (16) to (19).

The subcarrier oscillator is now locked to the burst, and under automatic phase control.

21. Trigger or synchronize your CRO from the ident waveform at TP10.
22. Observe the U vector output at TP7. Adjust the U phasing control (RV8) so that the demodulated bursts are equal in amplitude from line to line. Note that because the range of the U phasing stage is very wide, it is possible to swing the subcarrier phase so far that the U demodulator produces an ALT-V waveform! This facility is very useful (in conjunction with Fig. 17) for instruction purposes. The correct position for the wiper of RV8 is at or near the centre of its travel.
23. Observe the V switch output at TP11. Adjust RV12 so that the DC level on successive lines is identical.
24. Connect an RGB monitor to the respective outputs from the colour recovery unit. Do not terminate these outputs (see earlier text).
25. If necessary, balance the monitor's red, green and blue gun gains to produce a black and white picture with truly white highlights (Illuminant D_{6500}).
26. Without altering the saturation control setting, adjust the colour gain controls RV13 (RED), RV14 (GREEN) and RV9 (BLUE) so that a correctly coloured picture with a normal degree of saturation is produced. A colour bar signal should be used for this, and can be obtained from a transmitted test pattern if a suitable generator is not available.

The colour recovery system is now ready for service. The only user control is RV6 (Saturation).

VECTOR DISPLAY

The U and V outputs from the decoder may be applied to the X and Y axes of a CRT system, in order to produce a vector display. Commercial instruments which perform this function are known as vectorscopes, and processing is performed in the decoder circuit, the extension of this colour recovery system to a vectorscope would be quite simple and inexpensive if a mono-accelerator CRT were to be used.

COIL DETAILS

TR1 (4.43MHz)
PRI. 2T 26G B&S ECW
SEC. 15T 26G B&S ECW
Wind the primary first, and then continue on with the secondary so that the two windings lie side by side. The starts of each winding are indicated by a black dot on the circuit diagram.
L2 (4.43MHz)
WDG. 15T 26G B&S ECW
All formers NEOSID PC card mounting type: 2450/1/6W
All slugs NEOSID type 6x1x13x900 (13 mm long)
L3-L16
33uH video peaking chokes, AEGIS VPC 33, or similar.

What's new in Solid State

MOSFET FM front-end IC

First item of news this month is one which should be of interest to anyone building, or contemplating building, a receiver or tuner for the new FM broadcasts. It is a VHF front-end IC, the SD6000, which has just been released by Signetics.

Specifically designed for front-ends of FM tuners and other VHF receivers, the SD6000 incorporates MOSFET RF amplifier and mixer stages fabricated using DMOS technology. It is suitable for use with either varactor or conventional tuning systems, and is claimed to offer inherently superior linearity and cross-modulation performance.

Very little technical information has been provided on the device as yet, but the power gain at 100MHz is quoted as 30dB minimum, with a typical noise figure of 2.5dB. Price in 100-up quantities is around $1.20.

The brief data supplied states that the SD6000 comes in an 8-pin plastic package, but the picture shows 16-pin DIL devices. Take your pick!

Local agents for Signetics are Tecnico Electronics, at 53 Carrington Rd, Marrickville NSW 2204.

Another interesting new device just released is a precision low noise op amp from National Semiconductor, the LH0044. According to National, it represents the very state of the op-amp art, and can be used to replace hybrid modules and chopper-stabilised monolithic amplifiers.

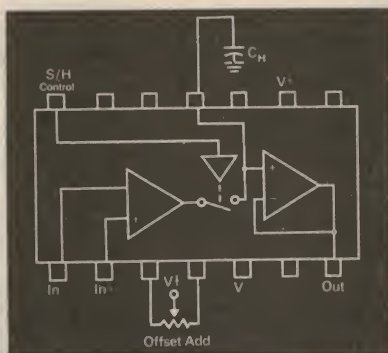
Apparently part of the secret of its performance is the use of metal film resistors in critical positions, with the resistors being trimmed to value using a laser. This together with advanced processing and testing techniques is claimed to minimise offset voltage and drift. The construction of the device has been designed to eliminate internal thermal feedback, too.

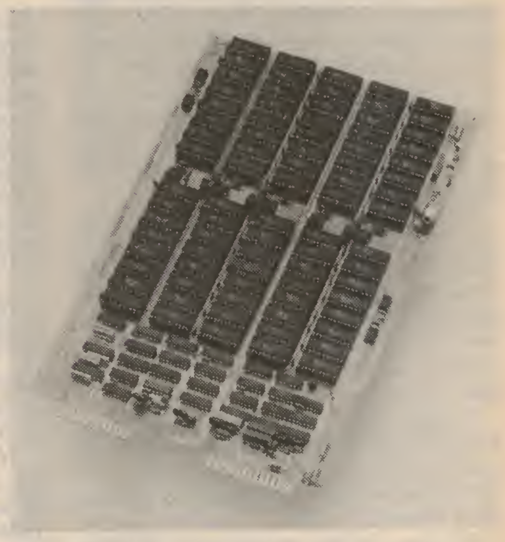
The specs look pretty good. Input offset voltage is less than 25uV; long term stability better than plus/minus 1uV per month; maximum offset drift 0.5uV/degree C; noise level lower than 0.7uV P-P from 0.1Hz to 10Hz; CMRR and PSRR are both 120dB minimum; open loop gain higher than 120dB; common mode range is more than plus/minus 13V. The LH0044 operates from plus/minus 2V to 20V.

The LH0044 comes in an 8-pin TO-5 can, with pin-outs matching the popular LM108, LM725 and LM741 to permit easy upgrading of existing circuits. Prices of the various grades of the device range from $7 to $42 for 100-up, in the US.

Local agents for National are NS Electronics, with offices in most states.

While still on the subject of esoteric op-amps, Harris Semiconductor has just released a new device called the HA-2420, which is fitted with an internal ana-





Above is the Harris HA-2420 sample-and-hold IC, while at right is a view of National Semiconductor's MOSRAM 104, a complete random-access MOS memory system of 16,384 words of 8 bits, on a single board.

log switch. This makes it capable of becoming a single-chip sample and hold circuit, by the addition of an external storage capacitor.

As you can see from the diagram, the HA-2420 in effect contains two internal op-amps, one connected as a unity gain follower. The output of the input amp is connected to the input of the follower via the analog switch, which may be controlled via an external command signal (TTL compatible). The input of the follower is also brought out for connection of the external hold capacitor.

Used with the external capacitor connected, it forms a versatile high performance sample-and-hold or track-and-hold circuit. Without the capacitor it may be used as a gated op-amp, for analog switching and peak holding applications.

Input bias current is 200nA max, open loop gain is typically 50k, and the aperture time is typically 50ns. Input and output voltage range is plus/minus 10V.

Prices in 100-up quantities start from around $15, and the HA-2420 comes in a 14-pin hermetic DIL package.

Local Harris Agents are Cema Distributors Pty Ltd, 21 Chandos St, Crows Nest, NSW 2065.

Cema have also announced the availability of a range of miniature high performance RF devices, from RF Power Labs, Inc of the USA. Included in the range are a wideband frequency doubler, type FD-1, which will frequency double over an input frequency range of 5-500MHz. It will take an input level of plus 10dBm, and has a conversion loss of 12dB.

Fundamental frequency rejection in the output is 20dB minimum, and the FD-1 needs no tuning or matching circuits. It comes in either a 14-pin DIL package, a TO-18 style metal can, or a rectangular stud mounting can.

There is also a series of miniature broadband bi-directional couplers, the DC-14 series, which are also in a 14-pin DIL package.

Typical of the series is the type DC14B/C, which will operate from 1-300MHz at a power level of up to 3W. It has 20dB coupling, 25dB directivity, 0.3dB insertion loss, a flatness within -0.3dB/plus 0.4dB, and a VSWR of better than 1.2:1 in 50 ohm circuits.

There is also a double balanced mixer series type DBM-14, again in a 14-pin DIL package. Various models give excellent performance up to 500MHz. No prices on the devices were available at the time of writing.

Finally, Hewlett-Packard Australia have released a new Application Note which deals with the use of silicon impatt diodes in high power microwave pulse applications. Designated No. 961, it also describes pulse amplifier and adder circuits. Copies are available free from HP offices in each state. (J.R.)

For further data on devices mentioned above, write on company letterhead to the firms or agent quoted. But devices should be obtained or ordered through your usual parts stockist.

Using one TV aerial for several sets

This article is based on one originally published in October 1959. It was written by Mr R. Lackey, then Chief Engineer of Antiference (Aust.) Pty Ltd. It has been modified and updated, in some cases in consultation with the author.

There has been a marked increase recently in queries concerning the connection of more than one TV set to an aerial. There appear to be two situations which are prompting this; the increasing number of people occupying home units, and the advent of colour TV.

TV reception in home units has always presented a problem. The bodies corporate almost invariably object to individual members erecting their own TV aerial on the roof. At the same time, they also flinch at the cost of a communal aerial and distribution amplifier which, strictly speaking, is the correct approach to the problem.

Most occupants do the best they can with an indoor aerial but this is a poor substitute. It is almost impossible to find a "clean" signal inside a building, and multiple ghosts are more or less inevitable. Nor is this problem a question of receiver quality, a fact which is seldom fully appreciated.

In good signal strength areas, at least, it should be possible to find a compromise solution. One medium to high gain aerial should deliver enough signal to operate from four to six sets, so that two aerials could conceivably service up to 12 units.

The other factor, colour TV, is apparently creating the situation whereby the old black and white set, being too good to trade in, is relegated to the rumpus room or spare bedroom for use by those household members who are not interested in the majority's program choice. Naturally, the temptation is to operate both sets from the same aerial.

Multi-element Yagi antennas, such as the Hills 215, or the Austenna model 406, are typical of the antennas envisaged in this article, but there is no reason why higher gain types could not be used where it would seem to be appropriate.

Fig. 1. The simplest arrangement, which will suit most domestic situations. The loss to each receiver is small and should not be a problem in the average suburban location.

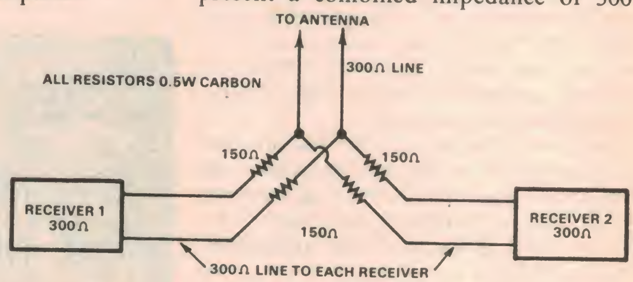


FIG. 1 FOR TWO RECEIVERS

As a general rule, it is not practicable to connect several sets directly in "parallel," because the resulting mismatch in impedance will cause multiple reflections of energy to and fro in the line, resulting in blurred images.

In addition, there will almost certainly be sufficient coupling between receivers to allow oscillator radiation to produce mutual interference, resulting in spurious patterns on the screens.

The problem thus becomes one of dividing signals in such a manner that each length of line is terminated at the receiver end by a load approximately equal to its characteristic impedance.

At the same time oscillator radiation must be attenuated.

The simplest method of multiple operation for two, three or four receivers each having 300 ohm input impedance is shown in Figs. 1, 2 and 3.

For five receivers the principle is the same, but 560 or 600 ohm resistors should be used; for six receivers, the resistors should be 680 or 750 ohms each.

In the case of Fig. 2, for example, the addition of two 300 ohm non-inductive resistors to the 300 ohm receiver input increases each line impedance to 900 ohms, but the three sub-circuits in parallel present a combined impedance of 300 ohms, to correctly terminate the feeder line from the aerial.

At the same time, the resistors provide a useful measure of isolation between receivers.

Where two sets are coupled in this way the loss to each set is 6dB, but the isolation between the sets is 14dB. For three sets the loss per set is nearly 10dB, and the isolation 22dB. For four sets the loss is 12dB and the isolation 28dB, for five it is 14 and 32dB, and for six, 15.5 and 36dB.

To preserve correct loading, if any receiver is disconnected from its individual line, a 300 ohm non-inductive half-watt or one-watt resistor should be connected across the end of the line.

Do not leave the end of an unused line either open or short-circuited.

In some locations, 300-ohm twin wire line is unsatisfactory because it picks up considerable interference from industrial electrical equipment, from nearby neon signs or from motor vehicle ignition systems.

This condition is most likely to arise where it is necessary to run a line down the front wall of a shop or building on a main road.

Again, there may be instances where more effective suppression of oscillator radiation is desired.

In these cases, an arrangement which employs co-axial cable, may be used, as shown in Fig. 4.

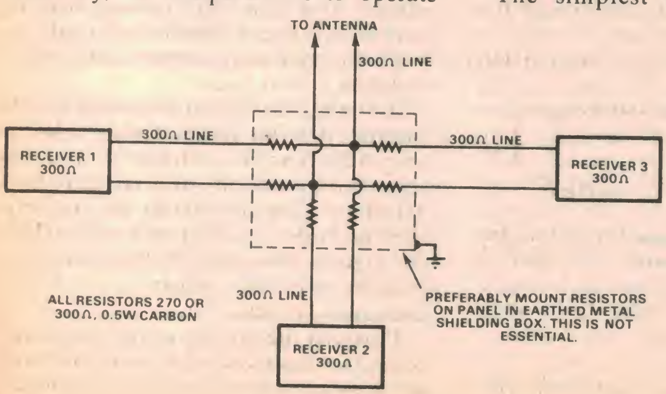


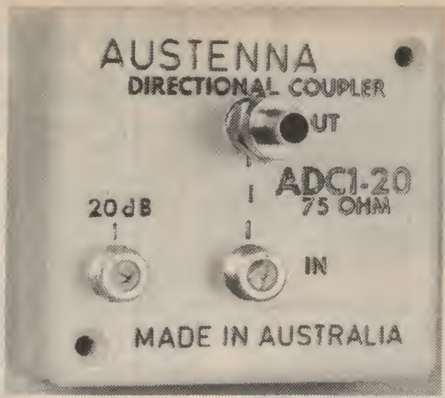
FIG. 2 FOR THREE RECEIVERS

Fig. 2. Where three sets are to be used the losses to each will be greater but should not be serious in good signal strength areas. In marginal cases a better aerial may be needed.

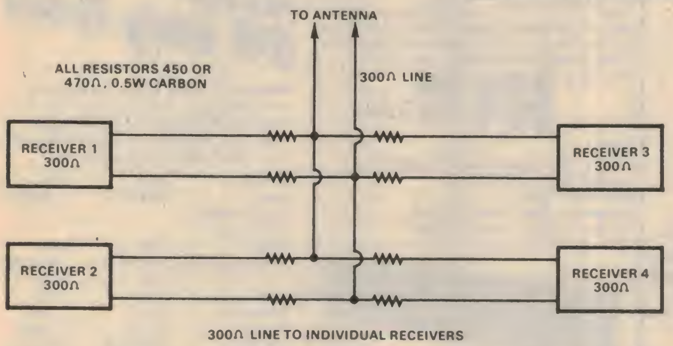
The shielding effect of the outer metal braid will normally improve the conditions mentioned but will attenuate the signals to a somewhat lower level than with the system illustrated in Figs. 1 to 3.

Aerials like the 215 or 406, although designed to feed into a 300 ohm line may be directly fed into a 72 ohm co-axial line without the necessity for a matching transformer or "balun" with its associated losses.

While it is possible to design baluns having losses of less than 1dB, many of these commonly encountered may have losses as high as 3 to 4dB; a good deal more than the loss occasioned by operating a 75 ohm receiver direct from such an aerial. (It should be appreciated that the impedance of such an aerial would be closer to 150 ohms than 300.)



Above: A commercial directional coupler as mentioned in the text. (By courtesy of Austenna (NSW) Pty Ltd.



Left: Fig. 3. A four-way, or larger, split will normally call for a good aerial in a good location.

Fig. 4 shows an arrangement which is particularly suitable for home units. A major advantage is that the line is permanently terminated and the system's behaviour is not upset by disconnecting individual sets, nor is it necessary to replace them with a dummy load.

In home units, this latter requirement could be an unacceptable one. It would be difficult to ensure that all occupants always fitted the dummy plug when a set was disconnected for repairs or other reasons. The result could be inconvenience to other occupants, possibly followed by arguments or recriminations.

In Fig. 4, the 72 ohm line is terminated in a 75 or 82 ohm non-inductive ½-watt or one-watt resistor to prevent reflections of energy back up the line.

Each receiver, up to a total of six, is connected to the 72 ohm line by means of a "pad" similar to those shown in Fig. 4. Resistor values can be the same regardless of whether two or six sets are connected.

The 680 ohm resistors are high enough to prevent each set loading the line unduly and to isolate each set against oscillator radiation from the others.

Receivers having a 300 ohm input impedance are connected, as at the left of Fig. 4, to terminals "A" and "B" of a pad.

Receivers designed for 72 ohm input impedance should be connected by co-axial cable to a pad with terminals "A" and "B" connected together and to the inner conductor, whilst the outer braiding should be connected to terminal "C".

With the system in Fig. 4 it is possible to have a mixture of 300 ohm and 72 ohm receivers operating at the same time.

If any receiver is disconnected, it is not necessary to connect a "load" in its place, as the line itself is properly terminated.

The losses to each set will be 20dB for the 300 ohm receiver and 26dB for the 72 ohm receiver. Isolation between any two sets will be between 40 and 53dB, depending on the combination of impedances.

For the system shown in Figs. 1 to 3, it is best to group all the resistors together in one location with individual lines radiating to each receiver.

With the system of Fig. 4, the individual pads should be located near each receiver and should be connected to the main co-axial line at points as widely separated as possible.

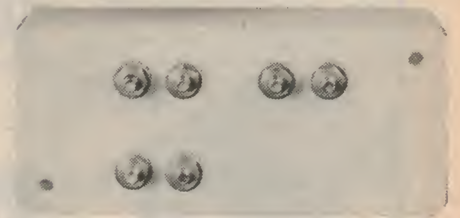
Special care should be taken in locating an aerial for a multiple receiver system, to place it in a high position well clear of power wires, neon signs or other sources of interfering signals.

A separation of at least 10ft between the aerial and power wires is desirable and preference should be given to mounting the aerial on the side of a building away from a roadway where motor vehicle ignition interference is likely to be severe.

A range of two, three and four way splitters, housed in plastic boxes and already fitted with correctly proportioned resistors are available from regular wholesale houses.

While the arrangements suggested above may not be suitable in all cases, due to insufficient signal strength, they have the advantage that they can be tried for a purely nominal cost; that of a few resistors and lengths of cable.

In the event that insufficient signal strength is available, particularly in home unit situations, the only solution is a distribution amplifier system. There is a good deal more to a system like this than the simple arrangements we have been describing, and such a situation usually calls for a professional organisation to assess the requirements and submit a quote.



A commercial version of a resistive splitter. Austenna (NSW) Pty Ltd.

It is not the purpose of this article to discuss such installations in detail, but a few points are worth noting. Even when an amplifier is used to lift the signal level, a good quality aerial is still desirable, since this is the only way to ensure a "clean" signal, with a minimum of ghosts.

A higher signal level makes possible an alternative approach to splitting the signal; the directional coupler. These are rather more complex devices than the simple resistive splitters described, but have the advantage of providing greater isolation between sets.

A typical coupler (illustrated) can be inserted in a line and introduce a loss of only 0.25dB as far as the next tap on the line is concerned. Its own tap introduces a loss of 20dB for signals passing from the line to the set, but not less than 40dB for signals generated by the set (local oscillator radiation, etc) and trying to pass back into the line.

Provided the far end of the line is correctly terminated, there is no requirement to terminate any of the taps with dummy loads when a set is disconnected.

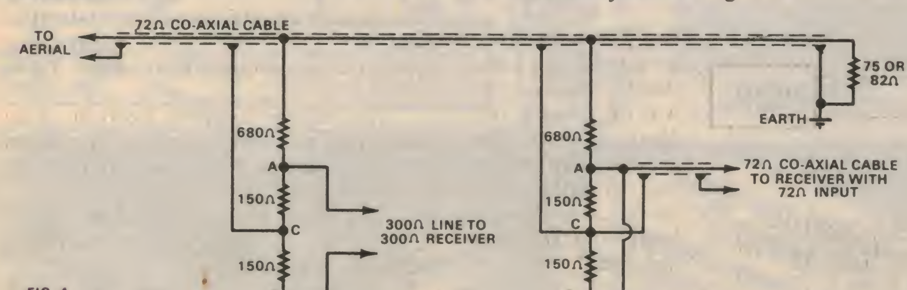


FIG. 4

Fig. 4. This arrangement will accommodate up to six receivers, either 300 or 75 ohm impedance (mixed), and does not require a dummy load in unused outlets.

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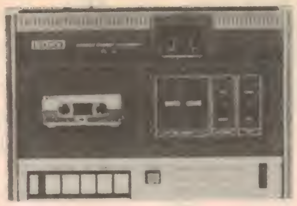

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Radio 300mV. Tape 30mV
Sig/Noise : 60db
Response : 20Hz-15kHz ± 1db
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SPECS	Z40	Z60
Input	100mV	100-250mV
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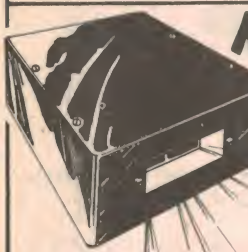
Response(± 1db)	10Hz-100 kHz	10Hz-200 kHz
Sig/Noise	64db	70db
Distortion	0.1%	0.03%
Supply	12-35V	12-45V
Size (mm)	55x80x20	55x98-15
PRICE (p&p $1.00	$17.00	$21.00

KITS



See (E.T. May 75)

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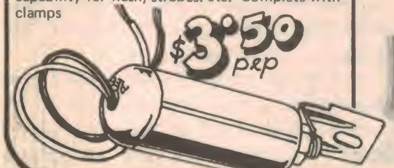

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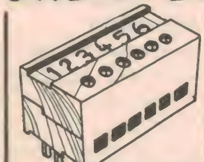
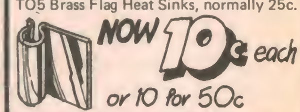
TO5 Cast Heat Sinks, normally 33c NOW **15c** each or **$1'00** for **10**



Deluxe 6 way terminal strip (0.1" spacing) normally 85c NOW 40c or 10 for $3.00

don't forget p&p 50c min! so buy more and save



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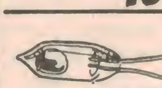

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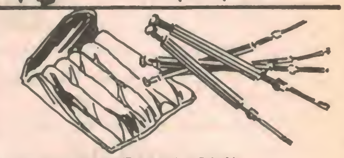
Rated at 1 AMP **$1'00** use as normally open or normally closed switch 1000's of uses ideal for car alarms!

170mm x 60mm
DIL BOARDS
Specially made for us to take up to 5D.I.L. IC's up to 16 pin. Makes assembly much easier than birdsnesting for prototypes etc. A quality board that is predrilled.

$1'50 each p&p



J4735 DRIVER KIT BACK AGAIN
A handy 6-piece jewellers set with free turning barrels in see-through vinyl case. Still at Newsletter price of **$1'40** p&p 50c

IN5400 DIODES
Ideal general purpose diode for power supplies, replacement use, etc. Handle 3A at 50V (6A in bridge). Packet of 10 $2.00

25c each or

have you visited our new York St. CITY branch? opposite Queen Victoria Building, 100 yds from Town Hall!

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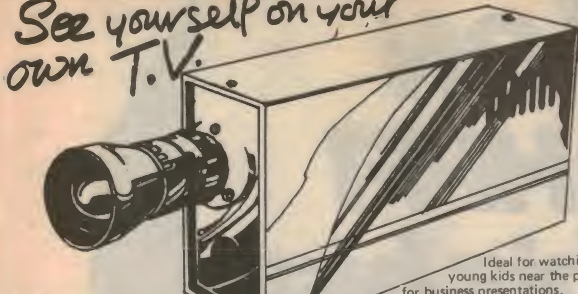
See yourself on your own T.V.



Ideal for watching young kids near the pool, for business presentations, security, anti-shoplifting, etc. or 1001 uses in industry. Supplied with 10M cable and TV set 300 ohm Balun. Tripod screw mount. A professional unit at nearly a third off!

BRAND NEW APECO CCTV CAMERAS

These cameras normally sell at $270, we have a limited quantity as a 'trial run'. Can be connected straight to a TV set. Fitted with f1.9, 12.5mm Cosmicar wide angle lens which can easily be changed. Vidicon responds to light levels as low as 40 lux. 240V operated. Focusses from 10" to infinity 500 line resolution.

$189.00 (p&p $5.00)

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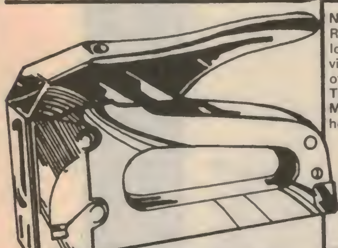
So many people have been asking for a bigger supply than our popular Dick. So here it is. Two ranges 0–12V–24V with a max. current of 1.5A. 3 transistor 7 diode circuit with meter readout of Voltage and Current. Voltage selector and variable control. Measures 18.5 x 10.5 x 8.5 cm weighs 1.5 kg (it's that well madell) Specially designed for instrument supply and the service bench. Fully regulated. Simply connect leads directly into Big Dick or mount and connect terminals supplied. Value at $39.50 (p&p $3.00).

TMA 8 STEREO/MONO MIXER AND PRE AMP

Easy to operate with slider controls for 4 mic. inputs which can be individually switched from 600 ohm to 50k. Also has phono magnetic input. Response from 30 to 20,000 Hz. Battery powered (2 x 216). Use as 4 channel mono or 2 channel stereo mixer. Only $44.85 p&p $1.00

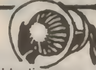


NEW RIVET GUNS

Rivets won't vibrate loose like nuts and bolts. Ideal for ham mobile equipment or anywhere vibration is a problem. Both guns take any length of 1/8" rivets.
T30 Light duty Gun $3.75 (p&p 75¢)
MR2 Professional Gun with 3 interchangeable heads. **14.75** (p&p $1.50).

1/8" (3mm) ALLY RIVETS IN 100 PACKS (Drill No. 30).

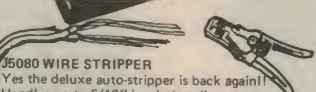
AB42	1/8"	thickness	$1.50 each
AB44	1/4"	grip	$1.75 each



5" INDOOR/OUTDOOR HORN

Ideal for any location requiring wide dispersion and medium power. High impact plastic housing 5½" dia by 3½" deep. Supplied with mounting bracket (all hardware is non-corrosive or rust-proof). Power: 5W Response: 300–10kHz. Dispersion: 90° Impedance: 8 ohm. Normally $13.90. Now $8.90. (p&p $1.00).

SPECIAL: Above unit with built-in siren module for alarms. Just connect to 12VII $22.50 (p&p $1.00).



J5080 WIRE STRIPPER

Yes the deluxe auto-stripper is back again!! Handles up to 5/16" insulation diameter. Fitted with stop for production use. Catalogued at $9.65. So save $2.50 at only $6.90 (p&p 75¢)

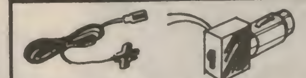
STAPLE GUN TACKER T55

Ideal for fixing our Intercom wiring and hundreds of stapling jobs. Suits wires up to 10mm diameter. Jam proof mechanism and all steel construction. Uses standard 10mm staples.

12.50 p&p 75c

T50WA Wire attachment holds wires in position while stapling to prevent damage. Only 90¢

STAPLES T50	1/4" long	$1.25 pack of 1,250
T51	5/8" long	$1.50 pack of 1,250



3 WAY CAR CONVERTER IN STOCK AGAIN

Fits any cigarette lighter and gives 6, 7.5 or 9V at up to 300mA. Supplied with polarity reversing extension cable and 4-way plug-socket adaptor which fits almost everything! Converter alone is usually $5.50. Get converter and adaptor lead for only $4.90. (p&p 75¢).

F.M. STEREO TUNER

Completely built FM tuner module incorporates a Stereo Multiplex Adaptor and receives stereo broadcasts automatically. A panel light (LED) indicates stereo reception. 10 transistors, 12 diodes. AFC and AGC. Operates from 6V drawing 20mA max. Handsome panel with dial drive mechanism. Measures 125L x 85D x 45H mm. Tuning range: 88-108MHz. Sensitivity: 10db for S/N 20db quieting. Image ratio: over 25db. Antenna: 75ohm. Output: 2 x 200mV. Separation: 30db at 1kHz. S/N ratio: 40db. Negative ground. Ideal for adding to amps and existing AM tuners.

29.75 p&p $1.00

ULTRASONIC WIRELESS SWITCH

Ready made units designed for Garage Door opening and other on-off switching applications like lights and TV etc.,

Operating distance	: up to 40ft.
Frequency	: 38kHz ± 2kHz
Operating Time Const.	: 1.2 sec
Power Source	
USO-12 Tx	: 9v transistor battery
USR-12 Rx	: 240v a.c.
Switch rating	: 250v a.c. 2.5A.(600w)

Complete system USO-12 plus USR-12 **$29.75** (p&p $1.50)

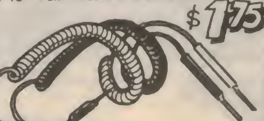
Extra transmitters USO-12. **$7.50** (p&p 75¢)

Note: The receiver operates as an alternate on/off device. Each signal from the transmitter changes the state of the receiver relay. A switch on the receiver also enables direct operation of the relay.

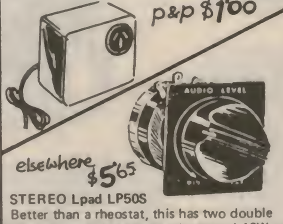
TL8C COILED TEST LEADS

A versatile set of leads, fully insulated. 6" probes (inc. tip) are slim enough to reach awkward test points. Phasetip meter plugs have fully insulated handles. Extedn to 96" (Yes – 8feetl) retract to only 16" Pair – red and black $1.75.

$1.75



LINE FILTERS 500W 2A rating **29.25** p&p $1.00



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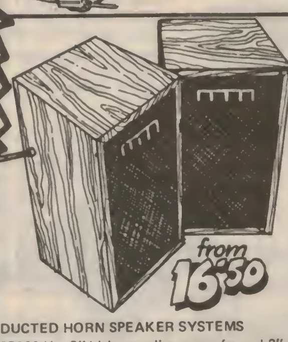
STEREO Lpad LP50S

Better than a rheostat, this has two double element ganged rheostats wirewound 10W peak rating 8 ohm. Ensures constant match with attenuation from 30db to 0.5db. Complete with instructions and 3/4" bushing for speaker mounting. Use this to extend your Hi Fi speaker system properly. our price $4.65

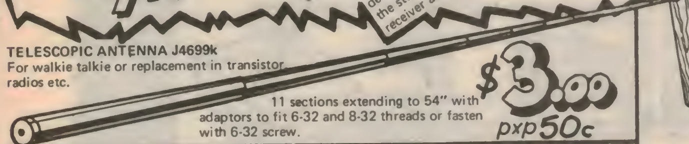
CROSS OVER NETWORKS

LN2 Two way LC network for 8 ohm systems. Single input splits to woofer and tweeter. Sealed metal can. **$3.50**

LN3 As above but for 3 speaker systems **$4.50**



from **16.50**



TELESCOPIC ANTENNA J4699k

For walkie talkie or replacement in transistor radios etc.

11 sections extending to 54" with adaptors to fit 6-32 and 8-32 threads or fasten with 6-32 screw.

$3.00 p&p 50c

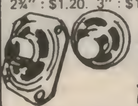
J4814 MORSE KEY

Ideal for Novice. (get our kit of electronic parts for your practice set). 5" key bar, 1" knob. We sold hundreds at $1.50, even more in our Newsletter. Only

1.00 p&p 50c

MINIATURE REPLACEMENT SPEAKERS

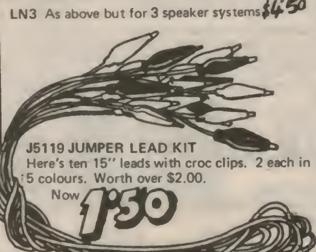
All 8 ohm. 2¼" : $1.00 2½" : $1.10 2¾" : $1.20. 3" : $1.50 each.



speakers from $1.00

DUCTED HORN SPEAKER SYSTEMS

SP620 Has 8" high compliance woofer and 2" tweeter with horn for better dispersion. Response from 60 to 16,000 Hz. 16" x 11" x 7" approx. Smart finish and handles 15W. Only $24.50 (p&p freight on).
SP625 Similar to above but with 6½" woofer, 2" tweeter 14½" x 9" x 5¾" approx. Handles 10W. 70 to 16,000 Hz. Ideal for use with Project 250 amp. Only $16.50 (p&p freight on)



J5119 JUMPER LEAD KIT

Here's ten 15" leads with croc clips. 2 each in 5 colours. Worth over $2.00. Now **1.50**

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- PREAMP/TONE CONTROL NETWORK BUILT-IN

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- 25 WATT PEAK TOTAL POWER (12.5W TOTAL RMS) INTO 8 OHM SPEAKERS
- GUARANTEED NO PARTS MISSING
- ALL PARTS READILY AVAILABLE
- PHILIPS CAPS, RESISTORS, MOTOROLA TRANSISTORS

☐ **PROJECT 250A KIT** includes fully built and tested amplifier, full circuit and suggested power supply circuit. Simply add your four pots — 3 x 50k dual log and 1 x 50k single linear — various wires and a power supply. Approx. 24-30V @ 1A. **AMAZINGLY LOW PRICE ONLY $14.95** (P & P $1.00).

☐ **PROJECT 250B KIT** exactly as 250A above but also includes four rotary pots. All you need to add is a power supply and some wire links. **$19.95** (P & P $1.50).

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☐ SP620 8" Woofer and 2" Tweeter in Cabinet. $24.00 (P& P FRIEGHT ON)

☐ SP625 6" Woofer and 2" Tweeter in Cabinet. $16.50 P&P (FREGHT ON)

Money back if not satisfied. Yes!! The usual Dick Smith guarantee applies to this kit. Inspect for 7 days and return if not satisfied, untouched, and we will refund your money less P & P.

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Resistors — how to combine preferred values

Producing non-preferred resistance values from preferred values can be a lengthy exercise, particularly when it is desired to know all the practical combinations which will give the desired value. The author has solved the problem by evolving a suitable computer program, the print-out of which is reproduced in this article. The author also discusses the effects of tolerance on the accuracy of the final value.

by THOMAS HAIN, B.Sc. (Hons) M.Sc.

With the advent of the new generation of general purpose resistors (eg, metal glaze) it is possible to place a much greater demand on their function. In particular, their temperature coefficient and long term stability is such that they may replace high stability or precision resistors in many design circumstances.

The problem then is how to make up those awkward values, between the standard values, with the fewest resistors (presumably two). The practice of "padding" is well known, in which one adds a small resistor in series, or a large resistor in parallel, to the main resistor to trim the overall value up or down until it is correct.

This method is not as efficient as possible, since it does not consider using two resistors of similar value. This is where the appended table comes in.

This table gives, in numerical order, all the values between one and ten that can be made up with two standard (preferred) value resistors, from the 10% range, connected either in parallel or in series. This does not limit the table to one decade, since the whole table may be multiplied by factors of 10.

To limit the number of combinations to a reasonable and justifiable figure the constraint is applied that the ratio of the two values is no greater than 100:1 or less than 1:100. The table gives combination values which are, on average, 0.36% apart and there are normally several combinations from which to choose.

Assuming that the purpose of creating a non-standard value is also to create a precise value, it may at first appear that these tables are useful only provided all standard resistors have exactly their nominal resistance. This is not true but, in any case, I have found that modern 5% values have a very small spread, typically of the order of 2%, and are centred quite closely on the nominal value.

If it is not possible to select resistors from a batch by measuring them, it will be necessary to use a closer tolerance resistor for at least one of the two in order to achieve the desired accuracy.

Let us consider the way in which the error of the composite resistor depends on the tolerance or error of the two individual resistors. In mathematical terms: eR = eR1 + eR2 for the series resistance case where eR, is the error of the composite register R, and eR1 and eR2 are the errors of the two series resistors.

Since tolerances (in terms of percentage) rather than actual errors are normally quoted for R1 and R2 the previous expression may be stated more usefully as:

$$T = \frac{T_1R_1 + T_2R_2}{R_1 + R_2}$$

where the T is tolerance, expressed in percent. Note that if one resistor is much larger than the other the accuracy requirements for the larger one are much more stringent.

In a similar way an expression may be derived for the parallel combination:

$$T = \frac{T_1/R_1 + T_2/R_2}{1/R_1 + 1/R_2}$$

Note that here if one resistor is much larger than the other the accuracy requirements of the smaller one are much more stringent.

In the above expressions T may be replaced by temperature coefficient, indicating that the requirements for the temperature coefficients may also be more stringent for one resistor than the other.

If the error of the composite resistor is to be minimised the contribution to the overall accuracy by the individual resistors (in either tolerance or temperature coefficient) should be equal. This implies that the ratio (inverse ratio) of the individual errors in the series case (parallel case) should not be greater than the ratio of the individual resistors .

From these considerations a general procedure can be developed for achieving odd resistance values using the appended tables:

(1) Find a convenient combination from the tables. One in which the resistance ratio is fairly large may be an advantage, since this means that the drift and temperature coefficient requirements are critical for only one of the two resistors.

(2) The larger (smaller) resistor in a series (parallel) configuration is the most critical since it will contribute the greatest part of the overall temperature coefficient and long term drift. The value of this resistor should be fairly close to nominal.

(In most applications a normal metal glaze resistor may be quite adequate but an Electrosyl high stability resistor would be advantageous in more demanding applications.)

(3) For a series (parallel) configuration select the smaller (larger) value such that the measured combination is within acceptable tolerance.

(4) It is possible that the range of values for the resistor mentioned in step (3) is incapable of producing a value within the required tolerance. In this case it will be necessary to go back to step (2) and choose another value.

The above procedure is used when resistors are being selected from a batch. This means that the tolerances are immaterial. What matters is the temperature stability and long term stability.

An example: A resistance of 91k, plus or minus 2%, is required. The table shows that 9.091 can be achieved by paralleling 10 and 100. Thus the resistors required are 100k and 1M in parallel. The tolerances, if selection is not possible, will be 1% and 10% respectively. Naturally, if the second tolerance is better than 10% it can do no harm.

If selection is possible the procedure would be to select 1M resistors (any tolerance) until the combination gives a value between 89k and 93k. In this case the tolerance of the 100k is not of importance, but the temperature stability is still 10 times more important than for the 1M.

Over the page will be found the computer print-out mentioned in the article. In the interest of accuracy it has been reproduced directly, rather than re-set. Also reproduced is the program from which it was made, for the benefit of readers who may wish to duplicate the exercise, or use it as a basis for a modified version.

RESISTOR COMBINATION CHART

1.000	S	.000	1.000
1.010	S	.330	.680
1.010	S	.010	1.000
1.012	S	.012	1.000
1.015	S	.015	1.000
1.018	S	.018	1.000
1.020	P	1.200	6.800
1.022	S	.022	1.000
1.027	S	.027	1.000
1.030	S	.470	.560
1.031	P	1.500	3.300
1.033	S	.033	1.000
1.039	S	.039	1.000
1.040	S	.220	.820
1.047	P	1.200	8.200
1.047	S	.047	1.000
1.056	S	.056	1.000
1.068	S	.068	1.000
1.070	S	.390	.680
1.071	P	1.200	10.000
1.080	P	1.800	2.700
1.082	S	.082	1.000
1.083	P	1.500	3.900
1.090	S	.270	.820
1.091	P	1.200	12.000
1.100	S	.100	1.000
1.100	P	2.200	2.200
1.111	P	1.200	15.000
1.120	S	.120	1.000
1.120	S	.560	.560
1.125	P	1.200	18.000
1.137	P	1.500	4.700
1.138	P	1.200	22.000
1.149	P	1.200	27.000
1.150	S	.330	.820
1.150	S	.150	1.000
1.150	S	.470	.680
1.158	P	1.200	33.000
1.164	P	1.200	39.000
1.165	P	1.800	3.300
1.170	P	1.200	47.000
1.175	P	1.200	56.000
1.179	P	1.200	68.000
1.180	S	.180	1.000
1.183	P	1.200	82.000
1.183	P	1.500	5.600
1.186	P	1.200	100.000
1.188	P	1.200	120.000
1.200	S	.000	1.200
1.210	S	.390	.820
1.212	S	.012	1.200
1.212	P	2.200	2.700
1.215	S	.015	1.200
1.218	S	.018	1.200
1.220	S	.220	1.000
1.222	S	.022	1.200
1.227	S	.027	1.200
1.229	P	1.500	6.800
1.232	P	1.800	3.900
1.233	S	.033	1.200
1.239	S	.039	1.200
1.240	S	.560	.680
1.247	S	.047	1.200
1.256	S	.056	1.200
1.268	S	.068	1.200
1.268	P	1.500	8.200
1.270	S	.270	1.000
1.282	S	.082	1.200
1.290	S	.470	.820
1.300	S	.100	1.200
1.302	P	1.800	4.700
1.304	P	1.500	10.000
1.320	S	.120	1.200
1.320	P	2.200	3.300
1.330	S	.330	1.000
1.333	P	1.500	12.000
1.350	S	.150	1.200
1.350	P	2.700	2.700
1.360	S	.680	.680
1.362	P	1.800	5.600
1.364	P	1.500	15.000
1.380	S	.180	1.200
1.380	S	.560	.820
1.385	P	1.500	18.000
1.390	S	.390	1.000
1.404	P	1.500	22.000
1.407	P	2.200	3.900
1.420	S	.220	1.200
1.421	P	1.500	27.000
1.423	P	1.800	6.800
1.435	P	1.500	33.000
1.444	P	1.500	39.000
1.454	P	1.500	47.000
1.461	P	1.500	56.000
1.468	P	1.500	68.000
1.470	S	.270	1.200
1.470	S	.470	1.000
1.473	P	1.500	82.000
1.476	P	1.800	8.200
1.478	P	1.500	100.000
1.803	P	2.200	10.000
1.818	S	.018	1.800
1.820	S	.820	1.000
1.822	P	2.700	5.600
1.822	S	.022	1.800
1.827	S	.027	1.800
1.830	S	.330	1.500
1.833	S	.033	1.800
1.839	S	.039	1.800
1.847	S	.047	1.800
1.856	S	.056	1.800
1.859	P	2.200	12.000
1.868	S	.068	1.800
1.880	S	.680	1.200
1.882	S	.082	1.800
1.890	S	.390	1.500
1.900	S	.100	1.800
1.919	P	2.200	15.000
1.920	S	.120	1.800
1.933	P	2.700	6.800
1.939	P	3.300	4.700
1.950	S	.150	1.800
1.950	P	3.900	3.900
1.960	P	2.200	18.000
1.970	S	.470	1.500
1.980	S	.180	1.800
2.000	P	2.200	22.000
2.000	S	1.000	1.000
2.020	S	.220	1.800
2.020	S	.820	1.200
2.031	P	2.700	8.200
2.034	P	2.200	27.000
2.060	S	.560	1.500
2.063	P	2.200	33.000
2.070	S	.270	1.800
2.076	P	3.300	5.600
2.083	P	2.200	39.000
2.102	P	2.200	47.000
2.117	P	2.200	56.000
2.126	P	2.700	10.000
2.130	S	.330	1.800
2.131	P	2.200	68.000
2.131	P	3.900	4.700
2.143	P	2.200	82.000
2.153	P	2.200	100.000
2.160	P	2.200	120.000
2.168	P	2.200	150.000
2.173	P	2.200	180.000
2.178	P	2.200	220.000
2.180	S	.680	1.500
2.190	S	.390	1.800
2.200	S	.000	2.200
2.200	S	1.000	1.200
2.204	P	2.700	12.000
2.222	P	3.300	6.800
2.222	S	.022	2.200
2.227	S	.027	2.200
2.233	S	.033	2.200
2.239	S	.039	2.200
2.247	S	.047	2.200
2.256	S	.056	2.200
2.268	S	.068	2.200
2.270	S	.470	1.800
2.282	S	.082	2.200
2.288	P	2.700	15.000
2.299	P	3.900	5.600
2.300	S	.100	2.200
2.320	S	.820	1.500
2.320	S	.120	2.200
2.348	P	2.700	18.000
2.350	S	.150	2.200
2.350	P	4.700	4.700
2.353	P	3.300	8.200
2.360	S	.560	1.800
2.380	S	.180	2.200
2.400	S	1.200	1.200
2.405	P	2.700	22.000
2.420	S	.220	2.200
2.455	P	2.700	27.000
2.470	S	.270	2.200
2.479	P	3.900	6.800
2.480	S	.680	1.800
2.481	P	3.300	10.000
2.496	P	2.700	33.000
2.500	S	1.000	1.500
2.525	P	2.700	39.000
2.530	S	.330	2.200
2.553	P	2.700	47.000
2.555	P	4.700	5.600
2.576	P	2.700	56.000
2.588	P	3.300	12.000
2.590	S	.390	2.200
2.597	P	2.700	68.000
2.614	P	2.700	82.000
2.620	S	.820	1.800
2.629	P	2.700	100.000
2.641	P	2.700	120.000
2.643	P	3.900	8.200
2.652	P	2.700	150.000
2.660	P	2.700	180.000
3.260	P	3.300	270.000
3.267	P	3.300	330.000
3.300	S	.000	3.300
3.300	S	1.500	1.800
3.313	P	3.900	22.000
3.328	P	5.600	8.200
3.333	S	.033	3.300
3.339	S	.039	3.300
3.347	S	.047	3.300
3.356	S	.056	3.300
3.368	S	.068	3.300
3.377	P	4.700	12.000
3.380	S	.680	2.700
3.382	S	.082	3.300
3.400	S	.100	3.300
3.400	S	1.200	2.200
3.400	P	6.800	6.800
3.408	P	3.900	27.000
3.420	S	.120	3.300
3.450	S	.150	3.300
3.480	S	.180	3.300
3.488	P	3.900	33.000
3.520	S	.820	2.700
3.520	S	.220	3.300
3.545	P	3.900	39.000
3.570	S	.270	3.300
3.579	P	4.700	15.000
3.590	P	5.600	10.000
3.600	S	1.800	1.800
3.601	P	3.900	47.000
3.630	S	.330	3.300
3.646	P	3.900	56.000
3.688	P	3.900	68.000
3.690	S	.390	3.300
3.700	S	1.000	2.700
3.700	S	1.500	2.200
3.717	P	6.800	8.200
3.723	P	3.900	82.000
3.727	P	4.700	18.000
3.754	P	3.900	100.000
3.770	S	.470	3.300
3.777	P	3.900	120.000
3.801	P	3.900	150.000
3.817	P	3.900	180.000
3.818	P	5.600	12.000
3.832	P	3.900	220.000
3.844	P	3.900	270.000
3.854	P	3.900	330.000
3.860	S	.560	3.300
3.861	P	3.900	390.000
3.873	P	4.700	22.000
3.900	S	1.200	2.700
3.900	S	.000	3.900
3.939	S	.039	3.900
3.947	S	.047	3.900
3.956	S	.056	3.900
3.968	S	.068	3.900
3.980	S	.680	3.300
3.982	S	.082	3.900
4.000	S	.100	3.900
4.000	S	1.800	2.200
4.003	P	4.700	27.000
4.020	S	.120	3.900
4.048	P	6.800	10.000
4.050	S	.150	3.900
4.078	P	5.600	15.000
4.080	S	.180	3.900
4.100	P	8.200	8.200
4.114	P	4.700	33.000
4.120	S	.820	3.300
4.120	S	.220	3.900
4.170	S	.270	3.900
4.195	P	4.700	39.000
4.200	S	1.500	2.700
4.230	S	.330	3.900
4.271	P	5.600	18.000
4.273	P	4.700	47.000
4.290	S	.390	3.900
4.300	S	1.000	3.300
4.336	P	4.700	56.000
4.340	P	6.800	12.000
4.370	S	.470	3.900
4.396	P	4.700	68.000
4.400	S	2.200	2.200
4.445	P	4.700	82.000
4.460	S	.560	3.900
4.464	P	5.600	22.000
4.489	P	4.700	100.000
4.500	S	1.800	2.700
4.500	S	1.200	3.300
4.505	P	8.200	10.000
4.523	P	4.700	120.000
4.557	P	4.700	150.000
4.580	S	.680	3.900
4.580	P	4.700	180.000
4.602	P	4.700	220.000
4.620	P	4.700	270.000
4.634	P	4.700	330.000
4.638	P	5.600	27.000
4.644	P	4.700	390.000
5.638	P	6.800	33.000
5.656	S	.056	5.600
5.668	S	.068	5.600
5.682	S	.082	5.600
5.700	S	1.000	4.700
5.700	S	.100	5.600
5.700	S	1.800	3.900
5.720	S	.120	5.600
5.750	S	.150	5.600
5.780	S	.180	5.600
5.790	P	6.800	39.000
5.820	S	.220	5.600
5.870	S	.270	5.600
5.900	S	1.200	4.700
5.930	S	.330	5.600
5.941	P	6.800	47.000
5.974	P	8.200	22.000
5.990	S	.390	5.600
6.000	S	2.700	3.300
6.000	P	10.000	15.000
6.000	P	12.000	12.000
6.064	P	6.800	56.000
6.070	S	.470	5.600
6.100	S	2.200	3.900
6.160	S	.560	5.600
6.182	P	6.800	68.000
6.200	S	1.500	4.700
6.279	P	6.800	82.000
6.280	S	.680	5.600
6.290	P	8.200	27.000
6.367	P	6.800	100.000
6.420	S	.820	5.600
6.429	P	10.000	18.000
6.435	P	6.800	120.000
6.500	S	1.800	4.700
6.505	P	6.800	150.000
6.552	P	6.800	180.000
6.568	P	8.200	33.000
6.596	P	6.800	220.000
6.600	S	3.300	3.300
6.600	S	2.700	3.900
6.600	S	1.000	5.600
6.633	P	6.800	270.000
6.663	P	6.800	330.000
6.667	P	12.000	15.000
6.683	P	6.800	390.000
6.703	P	6.800	470.000
6.718	P	6.800	560.000
6.733	P	6.800	680.000
6.775	P	8.200	39.000
6.800	S	1.200	5.600
6.800	S	.000	6.800
6.868	S	.068	6.800
6.875	P	10.000	22.000
6.882	S	.082	6.800
6.900	S	.100	6.800
6.900	S	2.200	4.700
6.920	S	.120	6.800
6.950	S	.150	6.800
6.980	S	.180	6.800
6.982	P	8.200	47.000
7.020	S	.220	6.800
7.070	S	.270	6.800
7.100	S	1.500	5.600
7.130	S	.330	6.800
7.153	P	8.200	56.000
7.190	S	.390	6.800
7.200	S	3.300	3.900
7.200	P	12.000	18.000
7.270	S	.470	6.800
7.297	P	10.000	27.000
7.318	P	8.200	68.000
7.360	S	.560	6.800
7.400	S	2.700	4.700
7.400	S	1.800	5.600
7.455	P	8.200	82.000
7.480	S	.680	6.800
7.500	P	15.000	15.000
7.579	P	8.200	100.000
7.620	S	.820	6.800
7.674	P	10.000	33.000
7.676	P	8.200	120.000
7.765	P	12.000	22.000
7.775	P	8.200	150.000
7.800	S	2.200	5.600
7.800	S	3.900	3.900
7.800	S	1.000	6.800
7.843	P	8.200	180.000
7.905	P	8.200	220.000
7.958	P	8.200	270.000
7.959	P	10.000	39.000
8.000	S	3.300	4.700
8.000	S	1.200	6.800
8.001	P	8.200	330.000
8.031	P	8.200	390.000
8.059	P	8.200	470.000
8.082	P	8.200	560.000
8.102	P	8.200	680.000
8.119	P	8.200	820.000
8.182	P	15.000	18.000

1.481	P	1.500	120.000	2.667	P	2.700	220.000	4.653	P	4.700	470.000	8.200	S	.000	8.200
1.485	P	2.700	3.300	2.670	S	.470	2.200	4.679	P	6.800	15.000	8.246	P	10.000	47.000
1.485	P	1.500	150.000	2.673	P	2.700	270.000	4.700	S	.000	4.700	8.282	S	.082	8.200
1.499	P	2.200	4.700	2.700	S	.000	2.700	4.720	S	.820	3.900	8.300	S	2.700	5.600
1.500	S	.680	.820	2.700	S	1.200	1.500	4.747	S	.047	4.700	8.300	S	.100	8.200
1.500	S	.000	1.500	2.705	P	3.300	15.000	4.756	S	.056	4.700	8.300	S	1.500	6.800
1.515	S	.015	1.500	2.727	S	.027	2.700	4.768	S	.068	4.700	8.308	P	12.000	27.000
1.518	S	.018	1.500	2.733	S	.033	2.700	4.782	S	.082	4.700	8.320	S	.120	8.200
1.522	S	.022	1.500	2.739	S	.039	2.700	4.788	P	5.600	33.000	8.350	S	.150	8.200
1.525	P	1.800	10.000	2.747	S	.047	2.700	4.800	S	1.500	3.300	8.380	S	.180	8.200
1.527	S	.027	1.500	2.756	S	.056	2.700	4.800	S	.100	4.700	8.420	S	.220	8.200
1.530	S	.330	1.200	2.760	S	.560	2.200	4.820	S	.120	4.700	8.470	S	.270	8.200
1.533	S	.033	1.500	2.768	S	.068	2.700	4.850	S	.150	4.700	8.485	P	10.000	56.000
1.539	S	.039	1.500	2.779	P	4.700	6.800	4.871	P	8.200	12.000	8.530	S	.330	8.200
1.547	S	.047	1.500	2.782	S	.082	2.700	4.880	S	.180	4.700	8.590	S	.390	8.200
1.556	S	.056	1.500	2.789	P	3.300	18.000	4.897	P	5.600	39.000	8.600	S	3.900	4.700
1.560	S	.560	1.000	2.800	S	.100	2.700	4.900	S	2.200	2.700	8.600	S	1.800	6.800
1.565	P	1.800	12.000	2.800	S	1.000	1.800	4.900	S	1.000	3.900	8.670	S	.470	8.200
1.568	S	.068	1.500	2.800	P	5.600	5.600	4.920	S	.220	4.700	8.718	P	10.000	68.000
1.579	P	2.200	5.600	2.806	P	3.900	10.000	4.935	P	6.800	18.000	8.760	S	.560	8.200
1.582	S	.082	1.500	2.820	S	.120	2.700	4.970	S	.270	4.700	8.800	P	12.000	33.000
1.590	S	.390	1.200	2.850	S	.150	2.700	5.000	P	10.000	10.000	8.880	S	.680	8.200
1.595	P	2.700	3.900	2.870	P	3.300	22.000	5.004	P	5.600	47.000	8.900	S	3.300	5.600
1.600	S	.100	1.500	2.880	S	.180	2.700	5.030	S	.330	4.700	8.913	P	10.000	82.000
1.607	P	1.800	15.000	2.880	S	.680	2.200	5.090	S	.390	4.700	8.919	P	15.000	22.000
1.620	S	.120	1.500	2.920	S	.220	2.700	5.091	P	5.600	56.000	9.000	S	2.200	6.800
1.636	P	1.800	18.000	2.941	P	3.300	27.000	5.100	S	1.800	3.300	9.000	P	18.000	18.000
1.640	S	.820	.820	2.943	P	3.900	12.000	5.100	S	1.200	3.900	9.020	S	.820	8.200
1.650	S	.150	1.500	2.970	S	.270	2.700	5.170	S	.470	4.700	9.091	P	10.000	100.000
1.650	P	3.300	3.300	2.988	P	4.700	8.200	5.174	P	5.600	68.000	9.176	P	12.000	39.000
1.662	P	2.200	6.800	3.000	S	1.500	1.500	5.194	P	6.800	22.000	9.200	S	1.000	8.200
1.664	P	1.800	22.000	3.000	S	1.200	1.800	5.242	P	5.600	82.000	9.231	P	10.000	120.000
1.670	S	.470	1.200	3.000	P	3.300	33.000	5.260	S	.560	4.700	9.375	P	10.000	150.000
1.680	S	.180	1.500	3.020	S	.820	2.200	5.302	P	8.200	15.000	9.400	S	4.700	4.700
1.680	S	.680	1.000	3.030	S	.330	2.700	5.303	P	5.600	100.000	9.400	S	1.200	8.200
1.688	P	1.800	27.000	3.043	P	3.300	39.000	5.350	P	5.600	120.000	9.474	P	10.000	180.000
1.707	P	1.800	33.000	3.071	P	5.600	6.800	5.380	S	.680	4.700	9.500	S	3.900	5.600
1.715	P	2.700	4.700	3.083	P	3.300	47.000	5.398	P	5.600	150.000	9.500	S	2.700	6.800
1.720	S	.220	1.500	3.090	S	.390	2.700	5.400	S	1.500	3.900	9.559	P	12.000	47.000
1.721	P	1.800	39.000	3.095	P	3.900	15.000	5.400	S	2.700	2.700	9.565	P	10.000	220.000
1.734	P	1.800	47.000	3.116	P	3.300	56.000	5.431	P	5.600	180.000	9.643	P	15.000	27.000
1.735	P	2.200	8.200	3.147	P	3.300	68.000	5.432	P	6.800	27.000	9.643	P	10.000	270.000
1.744	P	1.800	56.000	3.170	S	.470	2.700	5.455	P	10.000	12.000	9.700	S	1.500	8.200
1.754	P	1.800	68.000	3.172	P	3.300	82.000	5.461	P	5.600	220.000	9.706	P	10.000	330.000
1.760	S	.560	1.200	3.195	P	3.300	100.000	5.486	P	5.600	270.000	9.750	P	10.000	390.000
1.761	P	1.800	82.000	3.197	P	4.700	10.000	5.500	S	2.200	3.300	9.792	P	10.000	470.000
1.768	P	1.800	100.000	3.200	S	1.000	2.200	5.507	P	5.600	330.000	9.825	P	10.000	560.000
1.770	S	.270	1.500	3.205	P	3.900	18.000	5.520	S	.820	4.700	9.855	P	10.000	680.000
1.773	P	1.800	120.000	3.212	P	3.300	120.000	5.521	P	5.600	390.000	9.880	P	10.000	820.000
1.779	P	1.800	150.000	3.229	P	3.300	150.000	5.534	P	5.600	470.000	9.882	P	12.000	56.000
1.782	P	1.800	180.000	3.241	P	3.300	180.000	5.545	P	5.600	560.000	9.900	P	18.000	22.000
1.788	P	3.300	3.900	3.251	P	3.300	220.000	5.600	S	.000	5.600	9.901	P	10.000	1000.000
1.800	S	.000	1.800	3.260	S	.560	2.700	5.634	P	8.200	18.000	10.000	S	1.800	8.200

S - SERIES COMBINATION
P - PARALLEL COMBINATION
* - STANDARD VALUE FOR PRECISION RESISTORS

```
      PROGRAM START(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
      COMMON CR(612),K(612)
      DIMENSION R(38),CRR(4),RII(4),RJJ(4),HOL(4)
      DATA R/1E-100,1.,1.2,1.5,1.8,2.2,2.7,3.3,3.9,4.7,5.6,6.8,8.2,10.,
     1       12.,15.,18.,22.,27.,33.,39.,47.,56.,68.,82.,100.,120.,
     2       150.,180.,220.,270.,330.,390.,470.,560.,680.,820.,1000./
      IND=0
      DO 1 I=1,13
      LIM=24+I
      DO 1 J=I,LIM
      IF ((I.EQ.1).AND.(J.GT.13)) GO TO 1
      IF (J.EQ.1) GO TO 1
      IND=IND+1
      CR(IND)=R(I)+R(J)
      MAG=IFIX(ALOG10(CR(IND))+1.)-1
      CR(IND)=CR(IND)/(10.**MAG)
      K(IND)=I+J*100+10000*(MAG+1)
      IF(I.EQ.1) GO TO 1
      IND=IND+1
      CR(IND)=1./(1./R(I)+1./R(J))
      MAG=IFIX(ALOG10(CR(IND))+1.)-1
      CR(IND)=CR(IND)/(10.**MAG)
      K(IND)=I+J*100+100000+10000*(MAG+1)
    1 CONTINUE
      CALL ORDINC(IND)
      WRITE (6,6)
    6 FORMAT (1H1,25(/),44X,"TABLE OF RESISTANCE COMBINATION VALUES"//)
      DO 2 I=1,153
      IF (MOD(I,60).EQ.1) WRITE (6,8)
    8 FORMAT (1H1)
      DO 3 J=1,4
      IND=153*(J-1)+I
      CRR(J)=CR(IND)
      II=MOD(K(IND),100)
      JJ=MOD((K(IND)-II),10000)/100
      MAG=MOD((K(IND)-II-JJ*100),100000)/10000-1
      RII(J)=R(II)/(10.**MAG)
      RJJ(J)=R(JJ)/(10.**MAG)
      HOL(J)=1HS
      IF (K(IND).GE.100000) HOL(J)=1HP
    3 CONTINUE
      WRITE (6,4) ((CRR(J),HOL(J),RII(J),RJJ(J)),J=1,4)
    4 FORMAT (1H ,4(F13.3,2X,A1,F8.3,F9.3))
    2 CONTINUE
      WRITE (6,7)
    7 FORMAT (1H //1H ,"        S - SERIES COMBINATION"/
     1        1H ,"        P - PARALLEL COMBINATION"/
     2        1H ,"        * - STANDARD VALUE FOR PRECISION RESISTORS")
      CALL EXIT
      END
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```
      SUBROUTINE ORDINC(I)
      COMMON A(612),K(612)
      II=IFIX(FLOAT(I)/2.)
      DO 1 JJ=1,II
      JM=I-JJ+1
      JL=JJ+1
      AMIN=A(JJ)
      AMAX=A(JJ)
      MI=JJ
      MA=JJ
      DO 2 KK=JL,JM
      IF (A(KK).GE.AMIN) GO TO 3
      AMIN=A(KK)
      MI=KK
    3 IF (A(KK).LE.AMAX) GO TO 2
      AMAX=A(KK)
      MA=KK
    2 CONTINUE
      ASAVE=A(MI)
      A(MI)=A(JJ)
      A(JJ)=ASAVE
      KSAVE=K(MI)
      K(MI)=K(JJ)
      K(JJ)=KSAVE
      IF (MA.EQ.JJ) MA=MI
      ASAVE=A(MA)
      A(MA)=A(JM)
      A(JM)=ASAVE
      KSAVE=K(MA)
      K(MA)=K(JM)
      K(JM)=KSAVE
    1 CONTINUE
      RETURN
      END
```

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● Signal for standard colour test pattern ● Signals for red, green and blue raster ● Four-colour vector test signal ● Phase angle test signal for PAL decoder, using screen as indicator ● Electronic circle ● Grey scale, chessboard pattern, with 8 steps from white to black ● Three convergence pattern signals ● Positive or negative audio signal ● Modulated at 5.5 MHz or unmodulated ● Dimensions: 300 x 112.5 x 227 mm ● Weight: 4.3 kg.

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A small, handy, lightweight unit for rapid checking of colour TV receiver functions in the home or service department. The RF output level is either 30 mV or 1 mV into 240 Ohm. An electronic circle provides rational and precise methods for linearity alignments. The use of IC's affords high levels of reliability in the frequency divider stages. The colour sub-carrier and 5.5 MHz sound carrier may be switched off when not required.

● Four-colour vector test signal ● PAL phase angle test signal – decoder alignment employing screen display ● Convergence pattern signal with electronic circle ● Grey scale ● Red raster ● 5.5 MHz sound carrier ● Test Patterns: grid raster, 12 horiz. lines; 16 vertical lines; electronic circle faded-in; 4 colour bars, corresponding to the colour difference signals ● Dimensions: 220 x 80 x 165 mm ● Weight: 2 kg ● Accessories Supplied: 1 aerial cable 241; 1 protective cover for back of FG21.

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Suppressing RF interference from model railways

Do your neighbours complain loudly about buzzing noises in their radios when you operate your model trains? Does your TV picture suffer from little black lines when your children "play trains"? If so, then you can probably obtain relief by fitting RFI suppression components to your model railways.

by DAVID EDWARDS

Radio frequency interference, or RFI for short, is not usually of concern in the average household, as items like toasters and electric jugs do not usually suffer any detrimental effects when even large amounts of RFI are present. However, as more and more electronic equipment, in the form of TVs, calculators and other similar products, is brought into the home environment, effects can be observed due to RFI.

One of the most commonly seen interferences occurs when an electric model railway is operated in close proximity to a television set. The usual effect is for the picture to be covered with little black lines, which detract greatly from the pleasure (or otherwise!) of watching TV.

These effects, and other similar ones, can be eliminated by applying modern RFI suppression techniques. Before discussing the suppression circuits required, we will digress and give a short summary of the way in which RFI can reach a susceptible device, and the relevant international and Australian standards.

In general, there are two ways in which RFI can reach the radio, TV set, or other electrical equipment. At frequencies below 30MHz, the interference is primarily conducted along the mains wiring of the radiating device, and hence into the mains system itself. It is then coupled either inductively or capacitively into the electronics of the susceptible equipment.

The second way in which RFI can be propagated is by direct radiation. This occurs principally for frequencies above 30MHz.

To be effective, any suppression system or technique must eliminate or reduce both types of RFI to acceptable levels, as specified in the relevant standards.

The international standards for radiated and conducted interference levels are as laid down by the Comite International Special des Perturbations Radio electriques (CISPR). These have been used as the basis for Australian Standard 1044—Limits of Electro-magnetic Interference for Electrical Appliances and Equipment.

AS 1044 covers the electromagnetic spectrum in two ranges, from 150kHz to 30MHz, and from 30MHz to 300MHz. Limits are given for the allowable RFI in terms of terminal voltage for the lower band, and in terms of interference power and field strength for the upper band.

Table 1 gives the allowable limits for conducted RFI, measured in the approved manner at the mains terminals of the offending equipment. Where there is a frequency duplication at the boundary of the ranges, the lower limit applies.

For frequencies betweeen 30MHz and 300MHz, the limits are specified in terms of both power and noise field strength, to allow for both power and field strength measurements. The appropriate limits are given in Table 2.

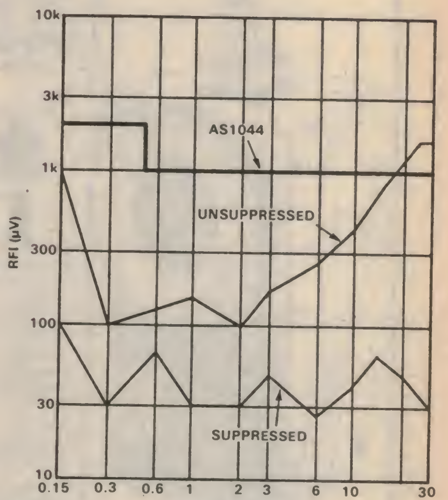


FIG. 1

High frequency interference with radio and TV reception occurs wherever commutation processes generate voltage or current transients. The main RFI sources in a model railway are the locomotive motor itself and the varying current transmission paths between rails and wheels and contact springs and wheels. The high frequency interference signals so generated propagate along the rails and supply leads, and reach the susceptible device by a combination of inductive and capacitive coupling, and by direct radiation.

In the frequency range of 150kHz to 30MHz, the interference is primarily conducted. Interference suppression is relatively easy in this band, particularly in smaller sized installations. It generally

TABLE 1
LIMITS OF TERMINAL VOLTAGE IN THE RANGE 0.15 TO 30 MHz

Frequency	Limits	
MHz	Hand held portable tools uV	Other appliances and equipment uV
0.15-0.2	3000	2000
0.2-0.5	2000	2000
0.5-30	1000	1000

TABLE 2
LIMITS OF INTERFERENCE POWER AND NOISE FIELD STRENGTH

Frequency	Limits	
MHz	Interference power dB(pW)	Noise field strength dB(uV/m)
30-300	45 rising linearly with frequency to 55	25 rising linearly with frequency to 35

TABLE 3
VALUES OF SUPPRESSION COMPONENTS

Gauge	HO	N
Motor	3uH VHF choke 0.047uF ceramic cap.	2.2 uH VHF choke 0.047uF ceramic cap.
Track supply point or transformer	0.68uF ceramic cap.	0.68uF ceramic cap.

Suppressing model trains

suffices to connect a 0.1 to 1uF capacitor permanently across the low voltage leads, either at the tracks or at the transformer. This will reduce the conducted interference to below the recommended level. Fig. 1 shows interference voltage curves for a small model railway before and after suppression.

Suppression in the 30 to 300MHz band is not so simple. A single suppression capacitor alone is almost entirely ineffective because the interference from the rails or leads and the locomotive itself is directly radiated. To be effective, the interference fields must be suppressed as close as possible to their origin.

The RFI from the motor is not difficult to suppress when the necessary suppression components such as VHF chokes and capacitors are located close to the motor connections.

Suppressing the current transmission paths is more problematic, however, as the rail/wheels interference source continually changes its position as the train moves. Successful suppression must be effective over the entire installation.

Each interruption in current flow at the current collectors, wheels and rails, for instance due to dirt, causes high frequency voltage transients in accordance with $u = L.di/dt$ where L is the rail inductance. Current interruptions cannot be avoided, but the inductive reactance between the rails can be compensated at high frequencies by discrete capacitors, placed across the rails at short intervals.

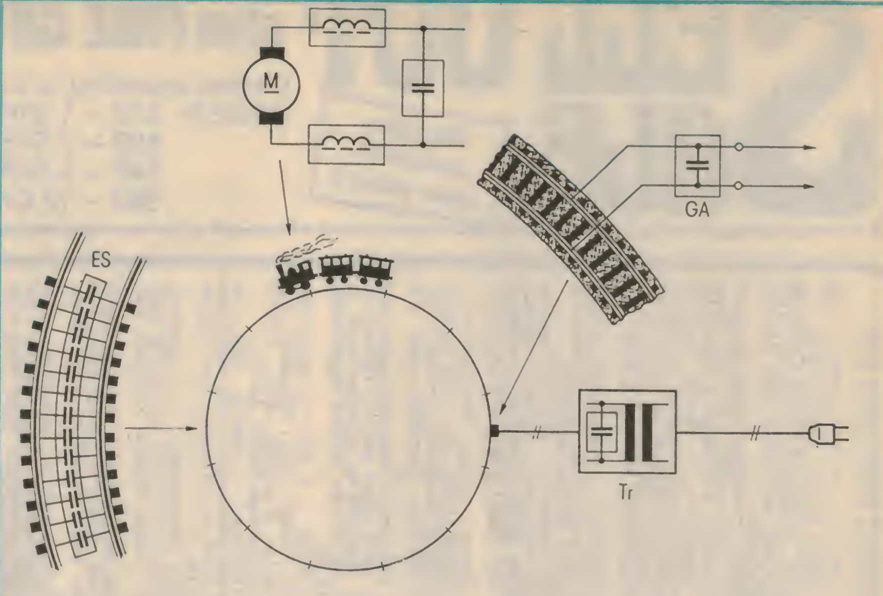
This method is complicated however, and the capacitor leads themselves are also inductive, making the compensation inadequate.

A uniformly distributed capacitance between the rails as shown in Fig. 2 is most effective. The metal layers with dielectric between them are embedded in the ties and form a capacitor distributed uniformly along the rails. The interference suppression obtained with this type of rail is good, as shown in Fig. 3. Without suppression, the interference exceeds the recommended standard by 10 times or more.

Interference suppression on the motor with two VHF chokes and a capacitor and suppression at the track supply terminals primarily reduces the interference field strength at low frequencies in the 30 to 100MHz range. Only the use of the suppression rail assures compliance with the recommended limit, however.

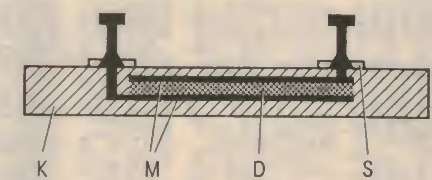
Unfortunately, this type of track is not available in Australia, so it will probably not be possible to obtain this degree of suppression. However there is no doubt room for experiment here, with multiple bypass capacitors along the track, and also perhaps home-made distributed capacitors. You could try making such capacitors using tinplate sheet, with thin PVC or mylar as the dielectric, and mounting the assembly underneath the track.

Fig. 4 gives a diagrammatic view of the basic suppression components required for a typical model railway. The values required are shown in table 3. Note that only VHF chokes and low impedance capacitors should be used.



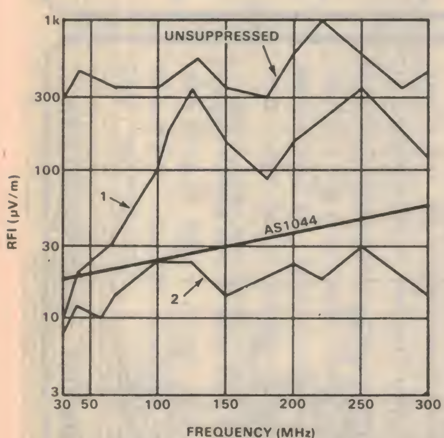
Tr	Transformer	ES	Suppression rail with distributed capacitance, equivalent circuit
GA	Track supply section, suppressed		
M	Motor with suppression components		

Fig. 4 (above): The basic RFI suppression techniques suggested for model train layouts. Component values are given in table 3.



M	Metal layers
D	Dielectric of the suppression capacitor
K	Insulating tie

Fig. 2: Cross-section of the type of track having an integral distributed suppression capacitor.



1 = MOTOR AND RAIL SUPPLY SECTION SUPPRESSED. NORMAL RAILS

2 = MOTOR AND RAIL SUPPLY SECTION SUPPRESSED. SUPPRESSED RAILS

FIG. 3

REFERENCES

1. Schaller, R., Radio Interference Suppression of Electric Model Railways. Siemens Components REPORT, Vol. IX, No. 4, 1974.
2. Australian Standard 1044-1973, Limits of Electromagnetic Interference for Electrical Appliances and Equipment.

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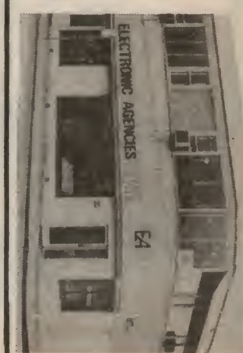

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113. 2-6 Volt Indicator Bezels — a beautifully chromed bezel complete with 6 Volt mini-globe. Available in red, green, amber. **$1.00.**

114. 6 Earphone Plugs/Socket sets — standard 3.5mm plugs and panel mounting sockets, available in red/black. **$1.00.**

115. 2 — Mono 6.5mm Plug/Socket sets — very useful for microphones, guitars, speakers etc. Comprises 2 plugs and 2 sockets (panel mounting) with changeover switch. **$1.00.**

116. 2 — Stereo 6.5mm Plug/Socket sets — for all stereo applications, comprises 2 plugs and 2 panel mounting sockets. **$1.50.**

117. 6 — RCA type plug/socket sets — standard audio input connectors for amplifiers etc. Comprises 6 plugs and 6 panel mounting sockets. **$1.00.**

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118. Stereo headphone control box — allows 2 pairs of stereo headphones to be operated from any amplifier fitted with a standard 6.5mm headphone socket. Each pair of headphones has its own slider volume control and a stereo/mono switch is included. **$5.50.**

119. 5-2 Pin Polarised Line Plug/Socket sets with covers. **$1.00.**

120. 8 — Standard 3AG In-Line Plastic Fuse Holders. **$1.00.**

121. Radio Dial Kit — handspan clear plastic circular dial, all states dial scales, bush, etc., to suit most Japanese plastic tuning condensers. **$1.00.**

122. Tuning Condenser with dial — standard ¾" x ¾", 200pf gang with radio dial kit as described above. **$2.00.**

123. 10 Asstd. potentiometers — ideal for experimenters and hobbyists. All new and useful — includes preset, ganged, switched and standard types. **$1.00.**

124. 12 Pot — Nuts and washers — shiny brass nuts and steel lock-washers. Keep 'em on hand — very useful. **$1.00.**

125. 6V DC — DC Car Convertor — plugs directly into any car cigarette lighter socket. For use with cassette tape recorder, transistor radio etc and provides regulated output up to 300 mA. **$6.90.**

126. 9V DC — DC Car Convertor — similar to above but 9V output **$6.90.**

127. Cassette Tape Splicer — for the adverturous cassette enthusiast or for repairing broken tapes, you need this handy little unit. Cuts and trims tapes in 2 operations — complete with instructions. **$3.95.**

128. 6" side — Cutting Pliers — real forged steel; hand finished by continental craftsmen. Made in Sheffield England; best quality for all radio work, with insulated handles. Normally priced around $2.95, our price just. **$1.95.**

129. 60 — Self-Tapping Screw Assortment. All Cadmium plated steel, various sizes suit radio and electronics work. **$1.00.**

130. 120 — Steel Washers Assortment — made of quality bright steel, various sizes and hole gauges, suit electronics assembly. **$1.00.**

131. 120 — High Grade Nut Assortment — various sizes incl. whit. and BA types and speed nuts, suit electronics assembly. **$1.00.**

132. 100 — Screw Assortment — incl. countersunk, round head, hex head and in various sizes, all cadmium plated — no rust. **$1.00.**

133. RCA Audio Leads — RCA phono plug each end of 1 metre shielded cable. Set of 2 for **$1.00.**

134. Ignition Suppressor Resistors — insert in HT leads to suppress ignition interference. Pack of 3 for **$1.00.**

135. Car Radio Suppression Kit — includes 2 suppressor condensers, 1 HT lead resistor, 6 adaptor lugs, mounting hardware etc., and illustrated instruction sheet. **$1.95.**

136. 3 — 240V Neon Bezels — safe, plastic neon indicators in orange, green, clear colours; include in built resistor, most popular types (normally 70c each) 3 for **$1.00.**

137. Experimenters pak of 30 assorted electroytics, all voltages; all new, quality stock. Range 10μF, 6V to 50V. Current price, approx. $6.72. Our bulk-buy price. **$3.00.**

138. Super Experimenters Pak containing 50 most popular useable electroytic capacitors, guaranteed new and high quality. Range 22μF to 3300μF, 6VW to 160VW. The normal price would be $11.48; but the price now is only **$4.50 (just 9c each).**

143. 2000mfd, 25VW Ducon Electros — brand new and guaranteed, insulated can type. 2 for **$1.50.**

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Forum

Conducted by Neville Williams

Snap reaction to "Instant Democracy"

Our item in the February issue about "Instant Democracy" electronic voting produced a fair amount of comment, by way of personal conversation, but less than we had expected in actual correspondence. By and large, most people seem to share our reservations about what we suggested might turn out to be "spur of the moment" democracy.

I was intrigued, however, by a letter from a New South Wales reader who, to borrow a phrase, seems to have "fired from the hip"—with a rather random result! I quote:

Dear Sir:

I read with interest M.F.'s proposal for Electronic Instant Democracy and I was somewhat disappointed at E.A.'s negative treatment of a proposal with obvious merits. True, there are a great number of difficulties, complications and even dangers involved, but that also applies to sending a man to the moon . . . A proposal of this nature, if made in earnest, requires study, not squashing. Inertia will get us nowhere.

If nothing else, Mr. F.'s forthrightness has prompted me to pass on a suggestion which has played around my head for some years. Perhaps it will also get hammered to death but then perhaps it will stimulate someone else again. Something useable may emerge sometime.

I am referring to the subject of numbers. At present I am the proud possessor of a great many variously numbered documents. Passport, 3 bank accounts, 4 driving licences, 3 credit cards, 2 vehicle registrations, an employee number, 6 credit accounts etc, etc. Would it not be advantageous to issue a person with a number at birth, to be used on all documents from then on? The number could reflect birthdate and place, sex, etc, etc. A system like this would revolutionize population statistics, simplify life and think what it would do to the crime rate!

Again, no doubt there are problems involved and no doubt also, many people will object violently (particularly people with desires for anonymity greater than privacy). I look at this way: I don't dig being a number, or being on any list, but I am anyhow, so let's tidy the list.

Toss that one into the barrel and see what comes out.

—J.M. (Lane Cove, NSW)

The first thing that intrigued us was the accusation of "E.A.'s negative treatment of a proposal with obvious merits". J.M. seems to have overlooked the fact that E.A. was presumably the only publication to take up the proposition and bring it to readers' notice.

In so doing, we took the trouble to explain why this and other proposals like it often fail to make the printed page. We then summarised the proposition to make it more acceptable for publication. A negative attitude?

In further comment, we sought to point out the likely problems in the correspondent's proposals, which he made light of or ignored in his enthusiasm for the idea. We thought we were being realistic but J.M. has branded our whole attitude "negative"; as tantamount to "squashing" M.F.'s proposition.

He ignores our acceptance of the problem as a real one, our commendation of M.F. for constructive thinking, and the suggestion that it should be thought through again: "it may have to go back to the drawing board".

I wonder if I can expose a personal "chip on shoulder"? In the current social mood, there seems to be an automatic merit in seeming to be "positive", "progressive", "uninhibited", "emancipated" and so on, through a whole range of adjectives. It doesn't matter how outlandish the point of view—it seems to acquire merit provided it can be described by one of these "in" words.

Conversely, one's opinions seem to demand some kind of an explanation or apology if they can be branded "negative", "conservative", "inhibited", "conventional" or such like. What utter rubbish!

It makes sense to advance and examine the "cons" of any new idea, along with the "pros" and we make no apology for so doing, adjectives notwithstanding!

The curious thing is that J.M. himself says: "True, there are a great many difficulties, complications and even dangers involved . . ." It almost seems as though it's okay to admit to difficulties, complications and dangers—as long as you don't spell them out!

Well so much for the chip . . .

I'm not quite sure where J.M. stands when it comes to his own idea for tagging everyone with a number, which would presumably take precedence over their name in all official documents.

He sounds like a conservative in his phrase "I don't dig being a number". But then his "let's tidy up the list" might put him with the progressives were it not for a suspicion that his "I am anyhow" betrays a readiness to conform; an unwillingness to rock the boat.

But, seriously, this is a matter on which one can only make a value judgment—using the values which are relevant to our present-day society.

Technically, there would seem to be little to stop the system being implemented as soon as it could be organised. From a certain date, babies would be allocated their own unique code at birth. Then, numbers would be allocated retrospectively for each preceding year until the whole population was classified and all official documents brought into line.

It would make for a high degree of efficiency in a computer-run society. In fact, a logical next step would be to brand every body with their own number, either by old-fashioned tattooing or by implanting a punched strip which could be electronically scanned for identification—voluntary or otherwise. There would be no more unidentified victims; no need to show one's driving licence when cashing a cheque—just bare your chest or whatever!

But would the price be too high for such bureaucratic and business efficiency? Do we really want to be lookalike cogs in a socio-economic machine—be it ever so smooth running? Should we not stand against the easy-going J.M.s of the world and fight for our names—and a multiplicity of documents—as bastions of individuality?

It's fashionable to talk, these days, about environment: the preference for rugged bushland over bowling greens or council parks; a windswept seafront rather than a foreshore drive; historic buildings rather than apartments.

Maybe there's something ludicrous about preserving the bush, and the seashore and old mansions for computer-dominated ciphers. But there I go again—being negative!

However, just to prove that the malady isn't chronic, I include, this month, an open letter written by Editor Jim Rowe to the authorities responsible for administering the regulations governing amateur radio stations. Jim is being positive—or so it seems. Hopefully, the authorities will see fit to give amateur station operators greater scope for their technical initiative.

The Controller, Radio Branch, P.M.G.'s Dept.

Dear Sir,

I am writing this letter to you in order to seek clarification and express concern regarding some of the regulations which apply to the operation of amateur radio stations in Australia.

Broadly speaking, there are various regulations applying to both the technical and general operation of amateur radio stations which seem difficult to justify. While there may well be valid reasons for them, it seems possible that in some cases at least they may exist in their present form more by default than by intention.

I draw attention to this situation because I believe that regulations, if they unnecessarily circumscribe the activities of radio amateurs, tend to negate the very purposes for which the amateur radio bands were set aside: to enable individuals and organisations to carry out amateur research and investigation into radio and allied techniques.

It occurs to me that in some cases the restriction on radio amateur activities may have resulted from the belief that all amateur radio transmissions should be potentially capable of being readily monitored. If this is the case, may I suggest that this philosophy could well be reconsidered.

It seems to me quite debatable whether or not a public authority should monitor the total content of such transmissions, apart from this being very costly. Providing the transmissions are not interfering with other services, and are identified at regular intervals, it could well be argued that the remaining content is of no interest or concern to anyone other than the amateurs concerned. This sort of conclusion would certainly seem to be in keeping with current social attitudes in other areas of human activity.

To be more specific, however, some of the aspects of the regulations which concern me are as follows:

1. ***No provision for pulse code modulation (PCM):** It would appear that Australian radio amateurs are not permitted to use PCM, on any band. Apart from the monitoring question, mentioned above, there does not seem to be any justification for this. Yet by preventing amateurs from experimenting with PCM, this aspect of the regulations effectively closes off a very significant and developing area of communications technology.*
2. ***Restriction of RTTY and FSK signals to 5-unit code:** Apparently the only teleprinter and/or FSK code permitted is the 5-unit International Telegraphic Code No. 2. Amateurs are thus prevented from using modern 8-level teleprinters and the more comprehensive ASCII code. This effectively prevents them from making use of surplus machines from computer systems, and also tends to prevent them from experimenting with asynchronous data transmission, modems, etc. As with PCM, this is a very significant and developing area of communications technology, in which amateurs could well make a useful contribution.*
3. ***Restriction of TV signals to pure "vision only":** This requirement would appear to prevent any experimentation with such important and valuable techniques as "sound in syncs", with alphanumeric data encoded during the vertical blanking interval, or with video encoding systems.*
4. ***No Morse transmissions by restricted licensees:** It would appear that at present, restricted licensees are prohibited from using Morse code, i.e., either A1, A2 or F1 modes, on any of the bands to which the restricted licence applies. This prohibition does not appear to have any obvious justification. Surely the ability to practice Morse on the 144-148MHz and higher frequency bands, perhaps in designated band segments, would do no harm, yet would encourage restricted licensees to build up their code speed.*
5. ***Total prohibition on music, all bands:** Presumably this was introduced to prevent misuse of amateur stations for entertainment broadcasting. However it is a "blanket" prohibition which would also appear to prevent any legitimate experimentation on modulation systems whose particular application may be to musical intelligence. Perhaps consideration could be given to restricted transmission of music, for test purposes only, on the 420-450MHz band and higher frequency bands.*

To summarise, the main point I am seeking to make here is that at present some of the regulations applying to amateur radio activities seem unduly restrictive, and to no valid purpose. I wonder if this could be remedied, to allow amateurs to carry out investigations in a less circumscribed fashion.

At present, amateurs almost seem to be restricted to using transmission modes and techniques which are already fairly well established. Easing of the restrictions to widen their sphere of potential activity would seem to me likely to reap benefits not only for amateurs, but for Australia as a whole.

Yours sincerely, J. Rowe

A state-of-the-art circuit for experienced constructors

A High Quality AM Synchrodyne Receiver

The recent introduction of FM transmissions has not reduced interest in high quality AM reception. Here we present details of an up to the minute tuner using an unusual "switching" synchrodyne detector with a TRF front end. Distortion is very low with wide audio bandwidth, while tuning whistles are completely eliminated by automatic muting circuits.

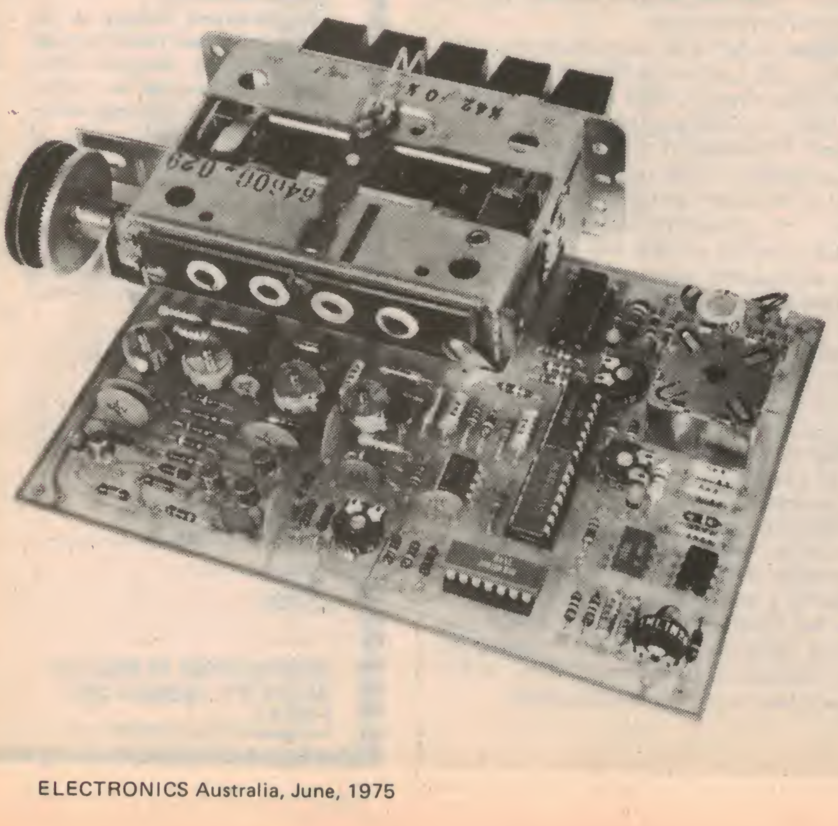
by PHILIP PIK

For at least the last two decades, the quality of AM transmissions has far exceeded the reception capability of most commercially available receivers. Until recently there was very little that could be done about this—complexity and cost of more elaborate receivers simply did not seem to be justified in the eyes of the general public. Whilst not too surprising an attitude in countries where FM broadcasting exists alongside AM transmissions, it is surprising to find it here in Australia where, until very recently, only AM was available.

It must be admitted that public interest here in hifi has only been awakened over the past decade or so and this is perhaps the reason for apathy towards AM transmissions. What did not help the situation was the fact that imported hifi equipment incorporating AM tuners only gave mediocre performance as far as the tuners were concerned. The reason for their low-key performance is understandable considering that in the main, the amplifiers are aimed at markets in countries that already have FM broadcasting.

When this project was embarked upon, FM had just been postponed two years. Therefore, as the author had been interested in hifi AM reception for many years, it seemed an opportune time to take on the task of building a receiver. Bearing in mind the fact that some experimental designs had already been published, it seemed appropriate to come up with a freshly engineered design, capable of at least approaching the excellent performance characteristics of AM transmissions.

Below is the prototype built around a push-button permeability tuner module.



The final receiver has been gratifying. Although by no means a simple design, complexity and component count has been minimised by extensive use of low cost integrated circuits. So in spite of the fact that FM transmissions have now begun, the results obtained with the completed receiver show that all is not lost with AM. With low distortion and wideband reception, AM transmissions can be a pleasure to listen to.

Before embarking on discussion of the receiver design, it seems appropriate to outline some ideal specifications and then perhaps see whether they are capable of being achieved, or are really necessary.

Ideally, one would like an RF sensitivity of 1uV plus an RF signal dynamic range of 120dB with an AGC range to match. Selectivity should be 10kHz and one would like to be able to receive a 1uV signal separated by only 10kHz from a 1V signal, without any cross-modulation, monkey chatter or 10kHz whistles.

However, since more than 90% of the people who may be interested in high-fidelity AM reception live in the cities or larger towns, a sensitivity of 1uV is useless since RF noise levels can exceed this level by at least two orders of magnitude or even three. By the time one takes into account RF interference from unsuppressed solid state light dimmers or typical "universal" motors used in small electrical appliances, a 1mV signal is the minimum to obtain a 50dB signal-to-noise ratio.

At the other end of the scale, because a reasonable percentage of the population live near transmitter masts, high signal level handling capability is very desirable, e.g., 1V signals are easily obtained with just a short aerial, up to 2km away from the transmitters.

Thus the front end sensitivity specifications can be altered significantly to cover the range of 1mV to 1V—a 60dB AGC range to match. The selectivity specification (to receive a 1uV signal 10kHz away from an unwanted 1 volt signal) also needs to be scrutinised. Whilst a synchronous detector is theoretically capable of resolving such a condition, practical limitations place a severe restriction on this range.

Broadcast authorities have never allowed two local stations to be 10kHz apart, and justly so as even the conventional narrow band superhet would have difficulty resolving two such signals. A reasonable figure then to put on selectivity would perhaps be 50kHz, at least in Australia. Sydney comes close to this with only 60kHz separation between 2CH (1170kHz) and 2UW (1110kHz).

Being a high fidelity receiver, the audio bandwidth needs to be as wide as possible. If the transmitted bandwidth is 10kHz, as in Australia, then the audio bandwidth needs to be at least equal to this. In practice this presents no problem if a synchronous detector is used.

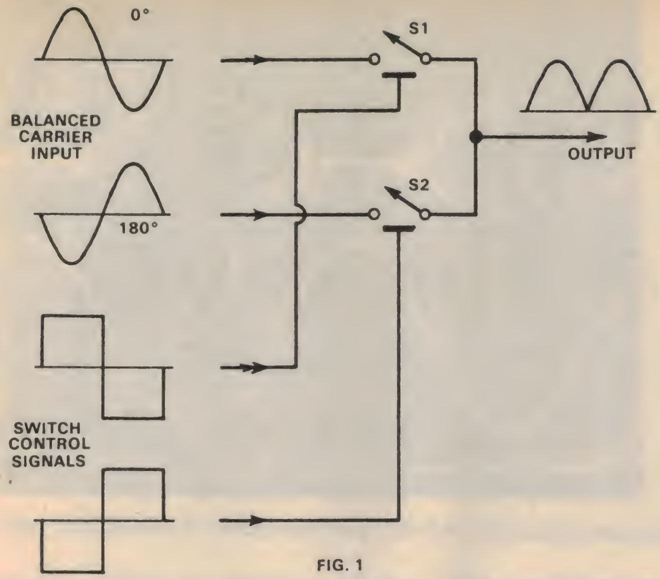


FIG. 1

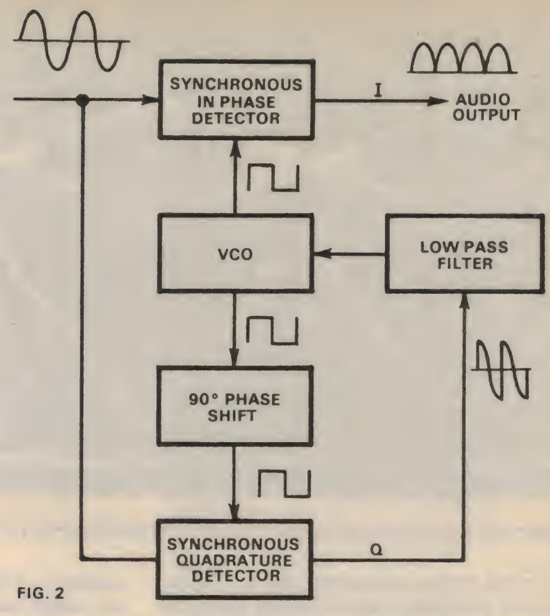


FIG. 2

Equally desirable as wide audio bandwidth is the lowest possible distortion in the detected audio signal. Using a synchronous detector it is theoretically possible to demodulate a 100% modulated carrier with very low distortion, say 0.01% THD (total harmonic distortion). In practice, it is difficult to achieve such a low figure but with careful design, THD may be kept below 0.1%. But even with careful design, the RF stage will add some distortion so perhaps a reasonable figure to expect for THD might be 0.2%.

Signal to noise ratio should similarly be as low as possible, preferably 60dB or more. With low sensitivity in the front end this is not difficult to achieve and in general will be limited only by atmospheric noise and electrical interference. In some instances, the station's own noise level may be the limit.

Spurious responses, i.e., cross modulation, birdies and monkey chatter, should also preferably be kept 60dB down. Again this is entirely a function of front end design. It is thus fairly obvious that the design of a high quality receiver lies not only in careful attention to the detector, but also to the front end.

The performance of the tuner to be described is summarised in the specification panel.

Although a description of the circuit might logically begin with the front end, it is practical to begin with the detector since it is the heart of the design. Also, an understanding of the detector will highlight some of the stringent requirements that need to be placed on the front end design.

Conventionally, the diode detector has been almost universally used. It is simple and gives quite a reasonable performance. Its limitations are its inability to faithfully recover 100% modulated signals and its non linearity with low signal levels. The first limitation is difficult if not impossible to overcome, but with careful design up to 90% modulation depth can be recovered with little distortion (about 3%). The second limitation can be minimised by ensuring adequate signal drive to the diode.

A further limitation of the diode detector is its inability to distinguish between modulation components presented to it by the wanted carrier and those from interfering carriers. With carefully designed "steep slope" IF stages, this limitation need not be of any consequence.

SPECIFICATIONS

Frequency range:	530-1650kHz.
Sensitivity:	500uV minimum. Max input level 50mV.
Frequency stability:	Oscillator stability not less than 500 ppm/°C with 20% mains variation and ambient temperatures ranging from 0°C to 50°C.
RF Bandwidth:	25kHz at 550kHz, 90kHz at 1650kHz.
AGC Characteristics:	Flat to within 1dB over 35dB range. Attack and decay times, 0.1 and 0.5 sec resp. for 30dB signal ratio.
Cross modulation:	Less than 1% with equal amplitude carriers modulated to 100% and separated by 40kHz at top end of frequency range. Greater separations and lower carrier frequencies give correspondingly less CM. With 100kHz separation less than 0.1%.
Spurious response:	60dB down on 500uV signal levels and above, except where CM specification exceeds this.
AF Bandwidth:	10Hz-10kHz ± 1.5dB.
AF Distortion:	1% maximum under all conditions, i.e., over entire audio frequency range, tuning range and RF input range and with up to 95% modulation.
Whistle filter:	60dB notch at 10kHz. Notch width (3dB pts) 150Hz. Filter may be switched out.
Signal-to-noise ratio:	60dB or more with signal level 500uV or more with respect to 100% modulation.
AF Output level:	Adjustable from zero to 1V at 100% signal modulation.
AF Output Impedence:	Less than 5 ohms; minimum load impedance 1k.
Power consumption:	15W at 240VAC; 10mA at 12V DC.

However, "steep slope" IF characteristics can lead to other problems, such as phase distortion of the audio signal.

Quite different from the diode detector is the "synchronous switching detector" featured in this tuner design. This is really nothing more than a switch actuated by a control signal at the precise moment the carrier waveform crosses the zero axis. Fig 1 illustrates the concept.

The incoming carrier is applied via balanced lines (one with zero phase, the other at 180 degrees out of phase) to a pair of CMOS switches. Square wave signals, locked to the incoming carrier, are applied to the switch gates. In the case of these switches, positive polarity gate signals turn the switches on and negative polarity turns the switches off.

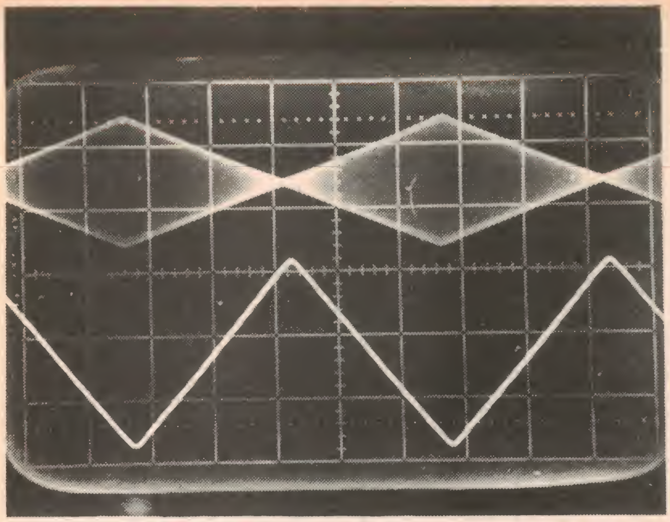
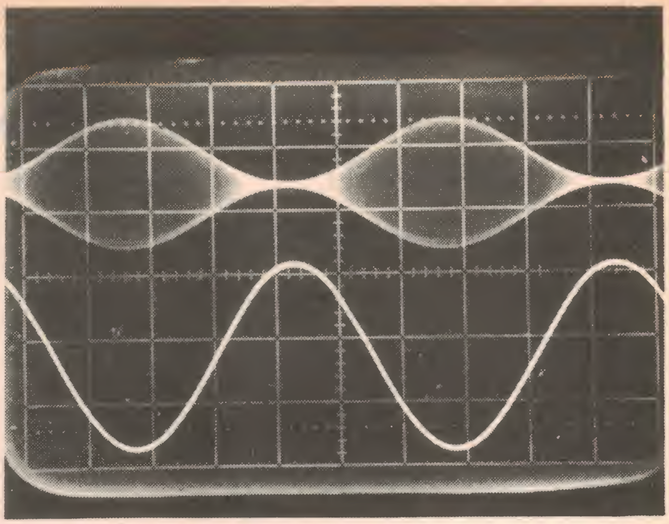
When the upper carrier waveform is "positive going" the switch S1 is turned on while S2 is turned off. Similarly, when the lower carrier waveform is "positive going", S2 is turned on while S1 is turned off. As a result, the output of the paralleled switches is a full-wave rectified version of the carrier. The peak value of the rectified waveform represents the carrier's amplitude modulation.

Since the detection method involves switches and does not have the linearity problems associated with diode detectors or product detectors, it is theoretically possible to demodulate an AM signal with very low distortion, as mentioned in the introductory paragraphs.

While this switching method of detection may be new as far as AM demodulation is concerned, particularly in the use of CMOS switches, the technique has been known for some time. In fact, in some ways it is similar to the 38kHz switching matrix used in the latest FM multiplex decoder ICs.

There are two methods of obtaining the control signals for the switches. The first is the synchrodyne method while the second is the homodyne. The difference between the two is that in the synchrodyne, the carrier is synchronously switched by a local oscillator, phase-locked to the incoming carrier. In the case of the homodyne, the synchronous switching signal is derived directly from the carrier by stripping it of its amplitude modulation.

Inability to completely recover a 100% modulated carrier without distortion using homodyne techniques still presents a problem, however. This is because, unlike the "synchrodyne driven" synchronous detector, where we have a strong local oscillator running continuously

These two oscillograms show the excellent linearity of the synchronous detector. In both cases the carrier is modulated 100%.

during the 100% modulation dip, the homodyne has theoretically no switching signal left at all during this period as the envelope contains no carrier. In practice this rarely occurs, but what does happen is that near 100% modulation phase jitter in the reconstructed carrier occurs. Thus the detector sees a switching signal with phase jitter superimposed. This leads to distortion of the demodulated signal. Out of band rejection is also a problem during high modulation depths.

Because of the above, the synchrodyne method of detection is used in the tuner under discussion. The only drawbacks are that the synchrodyne method results in a complex circuit and has the problem of strong heterodyne whistles as it is tuned to a station. Integrated circuits largely overcome the first drawback while the second is eliminated by an effective squelch circuit.

An interesting advantage of the synchrodyne (and homodyne) over the diode detector is the behaviour when interfering signals are present. Consider two signals 10kHz apart at 1MHz and 1.01MHz, with the latter interfering signal modulated by a steady tone of 2kHz. The two carriers beat together to produce the familiar 10kHz whistle — there is still no way of eliminating this problem apart from using a whistle filter.

The lower sideband of the interfering signal at 1008kHz beats with the wanted carrier at 1MHz to produce a beat note of 8kHz. Similarly the upper sideband produces a beat note of 12kHz. Thus, an audio output is produced from the interfering carrier's modulation — but it is not 2kHz. Frequency translation has occurred.

Now the important thing about all this is the fact that the lower modulating frequencies of the interfering carrier are turned into less noticeable signals higher up in the audio range. Vice versa, the interfering higher modulation frequencies cause interference at the lower end of the audio spectrum. Because of the nature of program material, the amplitudes of the higher modulation frequencies are down on lower and mid ranges, hence they are also less noticeable.

Thus, although adjacent channel interference is not eliminated, its subjective effect has been reduced. What remains sounds like monkey chatter.

One problem with the synchronous detector used here is that it is responsive to signals at odd harmonic intervals above the wanted carrier. For example, if the desired carrier is 540kHz, the detector will also demodulate a carrier on 1620kHz. This is somewhat similar to "image response" in a superhet tuner. Thus, some preselection is required ahead of the detector.

There is yet another reason for needing preselection. Potentially, the synchronous detector should be capable of a very wide dynamic signal range, but component limitations severely restrict this. It is desirable then to include some means of automatic gain control ahead of the detector so that it can operate under ideal conditions at all times. This allows it to be fully optimised with regard to its primary function—that of low distortion detection.

An explanation of the synchrodyne method as applied with synchronous switching detectors is now appropriate. This is illustrated in Figure 2.

As can be seen from the diagram, there are actually two synchronous switching detectors in this synchrodyne circuit and many readers will recognise it as a variation of a phase-locked loop (PLL). A voltage-controlled oscillator (VCO) with a square-wave output is locked to the incoming carrier. The VCO output is the switching control signal applied to the in-phase synchronous detector. The detected carrier is passed through a low-pass filter to become the audio output.

In addition, the output signal from the VCO is phase-shifted through 90 degrees and applied as the switching control signal to the quadrature detector. When the VCO is locked to the carrier, the quadrature detector will have no DC output. Any tendency of the VCO to fall out of lock with the carrier will cause the quadrature detector to produce a DC error signal, which is fed via the low-pass filter to the VCO to pull it back into lock.

The "discrete" form of detector presented here was decided on after experimenting with an off-the-shelf detector, the well known Signetics NE561B. Trials were conducted using this but tracking difficulties and high levels of distortion (well in excess of 1%) were encountered. Out of band rejection was also found to be poor, requiring the use of highly selective tuned circuits ahead of the detector to eliminate adjacent channel interference.

The complete synchrodyne circuit comprises IC2, IC3, IC4 and the circuitry associated with the FET F4 and varicap V1. The in-phase and quadrature detectors are both provided by a four-channel bilateral CMOS switch IC, type 4016 (IC2) from Solid State Scientific. Two switches are used for each detector to give balanced or full wave operation. To drive the switches two signals are needed, of identical frequency but 90° phase shifted. Because the detector is tunable, the frequency of the driving signals must be able to be varied, with the proviso of maintaining an exact 90° phase shift relationship between them.

While this would present considerable problems if analog circuitry were used, it is straightforward in digital form. The VCO is run at four times the carrier frequency and its output then applied to a dual JRS flip-flop, SSS4013, wired as shown, to obtain two separate outputs locked to the carrier frequency but maintaining an exact 90 degree phase shift.

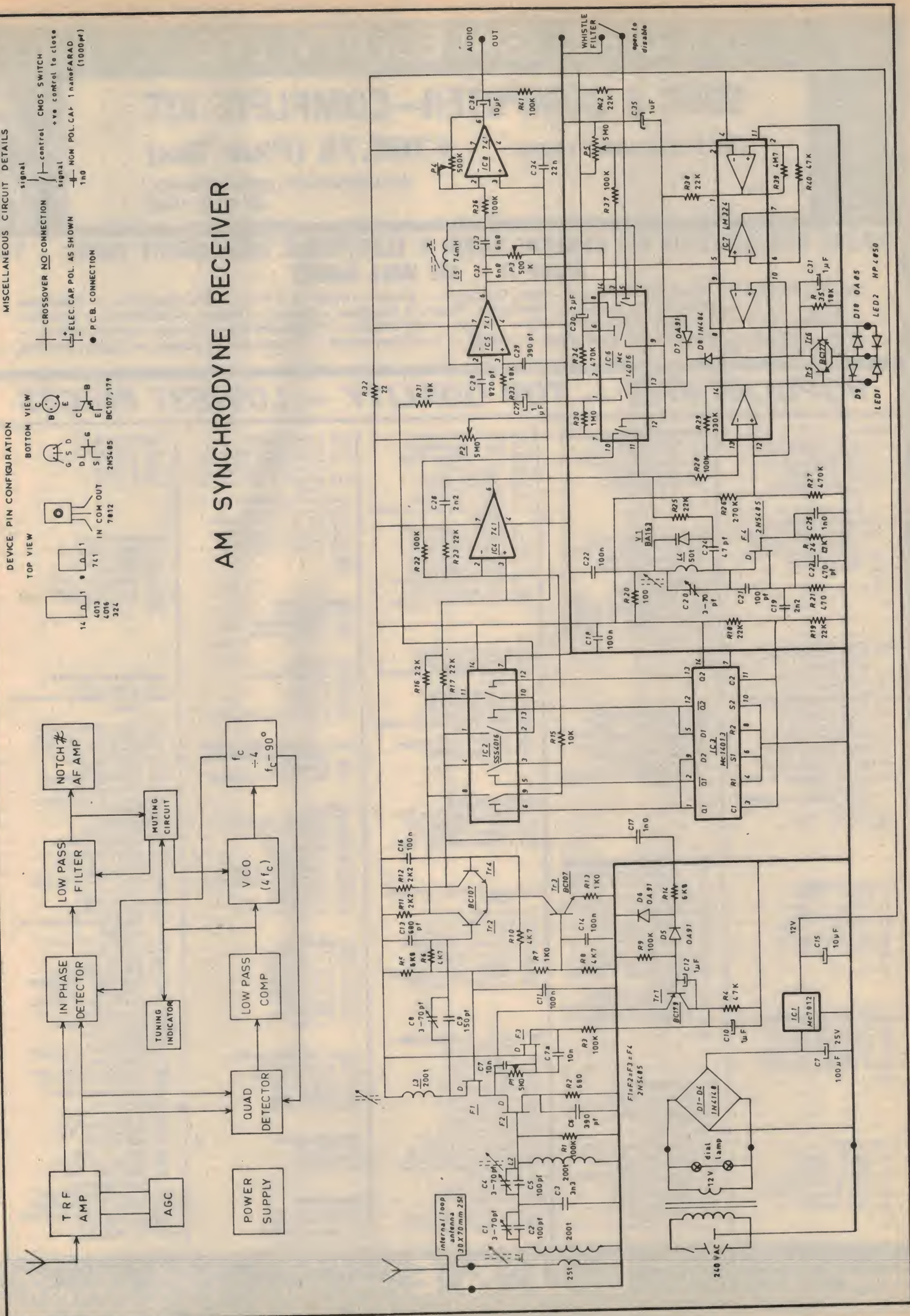
Output from pins 2 and 10 of IC2 is the in-phase detector output while that from pins 9 and 3 is the quadrature output.

Those familiar with the design of PLL's will note the lack of a limiter preceding the quadrature detector. Although desirable, limiters in themselves can present problems. In this instance the inclusion of a limiter turned out to be a decided disadvantage, as unsymmetrical limiting, particularly at higher operating frequencies was a problem. Symmetrical clipping and complete freedom from amplitude modulation, in particular, are essential if the detector is to function properly at all. Complete rejection of AM is difficult, even with as many as five stages of limiting.

So instead of designing a detector with at least some dynamic range, one with a fixed carrier input level was opted for. The required gain for optimum VCO lock and holding is thus more readily satisfied and constant signal levels make it easier to design the following stages. The only proviso was that adequate gain has to be provided to amplify the output from the quadrature detector. This is provided by the low-pass filter op-amp, IC4, which is a common 741 type.

The voltage controlled oscillator is of conventional colpitts configuration using a FET instead of a bipolar device. Because of the inherent stability of junction capacitances of FET's, especially in relation to temperature and voltage, the stability of the oscillator is very good. Now it may be argued that stability is not of prime importance in a phase lock loop used for the purposes of demodulation. However, if tuned circuits are used ahead of the detector, stability becomes important. If the oscillator drifts, the loop will lock in a different dial position, thereby detuning the resonant preselection circuits.

Tuning the VCO to its basic operating frequency (at four times the carrier) is accom-


AM SYNCHRODYNE RECEIVER
TRF AMP
AGC
POWER SUPPLY
IN PHASE DETECTOR
QUAD DETECTOR
TUNING INDICATOR
LOW PASS COMP
LOW PASS FILTER
MUTING CIRCUIT
VCO (4 fc)
fc ÷4 fc-90°
NOTCH AF AMP
DEVICE PIN CONFIGURATION
TOP VIEW
BOTTOM VIEW
4013 4016 324
741
IN COM OUT 7812
2N5485
BC107,179
MISCELLANEOUS CIRCUIT DETAILS
CROSSOVER NO CONNECTION
ELEC. CAP. POL. AS SHOWN
P.C.B. CONNECTION
CMOS SWITCH +ve control to close
NON POL. CAP: 1 nanoFARAD (1000pf) 1n0
AUDIO OUT
WHISTLE FILTER
open to disable
internal loop antenna 38 X 70mm 25t
F1=F2=F3=F4 2N5485
240 VAC
12V
dial lamp
D1-D4 1N4148
IC1 MC7812
IC2 SS54016
IC3 MC14013
IC4 741
IC5 741
IC6 MC14016
IC7 LM324
IC8 741
V1 BA163
LED1
LED2 HP4850

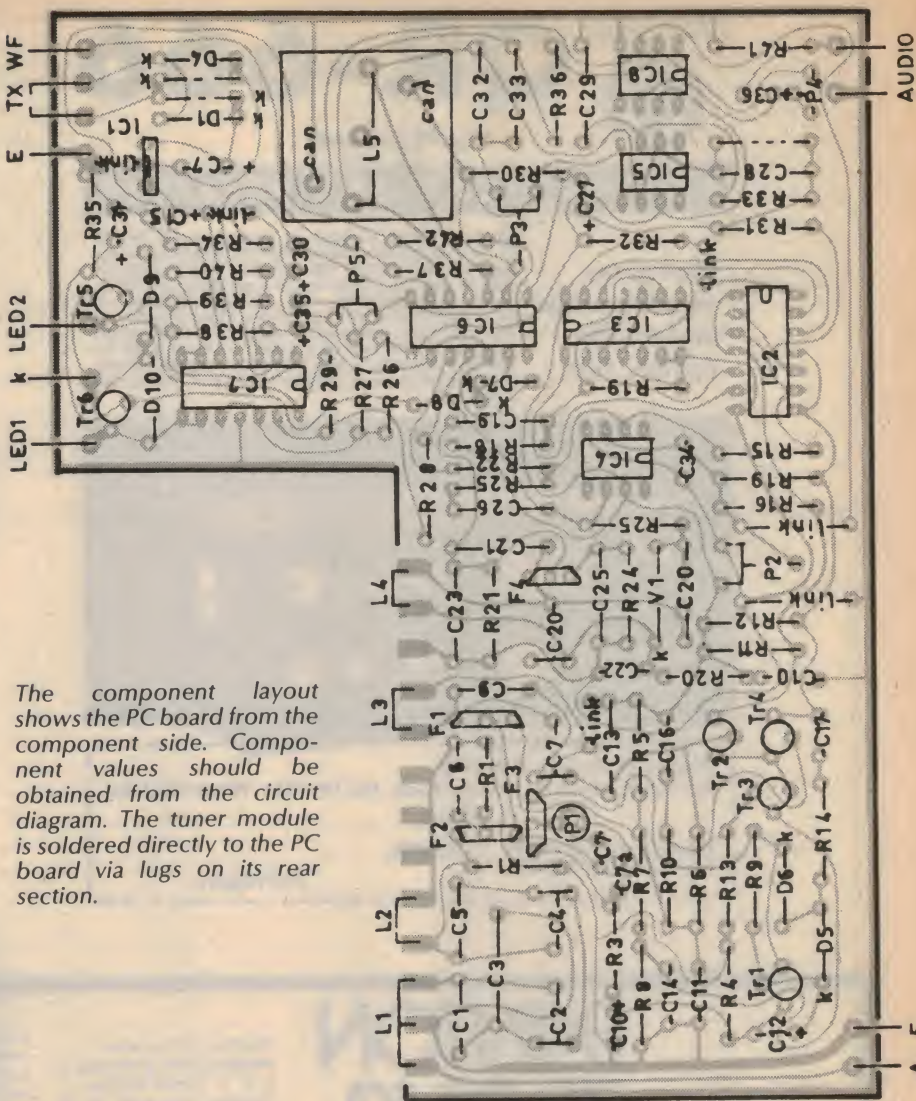
plished by a variable permeability tuner module. Voltage control of the VCO is accomplished with a varicap diode, V1. Note that V1 is not connected directly across the tuned circuit but is connected via a 47pF capacitor to linearise its voltage/capacitance relationship.

Having described the operation and signal requirements of the detector system, we can discuss the front end. Here, a tuned radio-frequency stage (TRF) was decided upon instead of a superhet, because the major feature of a superhet, selectivity, was not required and because it is easier to design a TRF to obtain low distortion and satisfactory noise performance.

The TRF stage consists of a pair of FET's in cascode configuration with AGC applied by FET F3. A balanced detector drive is provided by a "long-tailed" pair consisting of Tr2, Tr4 and Tr3. AGC voltage for F3 is developed from the collector of Tr4 by a pair of voltage doubling diodes, D5 and D6, and then amplified by Tr1 which acts to minimise any loading on Tr4. As well as acting as a buffer, Tr1 functions as a capacitance multiplier to provide long AGC time-constants without the use of large capacitors. C12 is multiplied by the gain of Tr1.

As the schematic shows, a total of four variable tuned circuits have been used, three for the RF stage and one for the detector. A four gang tuning capacitor is rather cumbersome and expensive, so a permeability tuner was chosen.

In order to minimise the generation of cross and inter modulation, a coupled tuned circuit is used as a passive pre-selector stage. The coupled circuit allows a humped response to be obtained with good skirt selectivity. L1 minimises any loading effects from an externally connected antenna, which could adversely affect the tuning of the coupled circuit. In addition, it provides optimum matching to the loop antenna. The third tuned circuit in the drain of the cascoded FET stage is tuned to the centre of the hump and thus flattens out the passband ripple.



The component layout shows the PC board from the component side. Component values should be obtained from the circuit diagram. The tuner module is soldered directly to the PC board via lugs on its rear section.

AGC time constants have been chosen to provide a fast attack (0.1 sec.) and slow decay (0.5 sec.) time. Large time constants are necessary to avoid demodulation and distortion of the carrier envelope at low frequencies. A fairly fast attack time was chosen to minimise transient overloads while tuning. As signal fading is not a problem with local reception, the long decay constant does not present any problems. At low levels of AGC, F3 operates on the non-linear portion of its transfer curve. To avoid distortion (ie, cross modulation and envelope distortion) boot strapping of the AGC signal between source and gate is used to linearise the effective resistance of F3.

Comparing the receiver's front end specifications with those postulated in the introductory paragraphs, it will be noted that they come somewhat short. The signal handling range, AGC range and cross modulation performance are all about 20dB less than desirable. For the time being though, until the author can develop a better front end using dual-gate MOSFETS, this circuit offers reasonable results considering its relative simplicity.

Several sections of the circuit remain to be discussed. The first of these is the low pass audio filter which removes high frequency garble above about 15kHz from the output of the in-phase detector. The filter is a unity gain Sallen and Key circuit built around a 741 op amp IC5. This provides a low output impedance to drive the passive notch filter, L5 and associated components which effectively removes any 10kHz whistle. The "notch" gives 60dB rejection at 10kHz and the width of the notch at the minus 3dB points was 150Hz.

A buffer amplifier is provided following the whistle filter so that loading effects of the external amplifier connection do not affect its performance. The buffer amplifier consists of a 741 op amp, IC8, with a gain control in the feedback network to adjust the output signal level.

A quad op-amp, IC7, type LM324N from NS Electronics and another four channel bilateral CMOS switch IC type 4016, IC6, are used to provide tuning indication and suppression of tuning whistles. Operation is as follows:

Two op amps in the LM324N function as a comparator to monitor the difference between input and output of the PLL low pass filter IC4. If the PLL is locked to an incoming carrier, there will be no difference in voltage between the input and output of IC4. If an error voltage does occur, as when tuning towards a station, the comparator output will be either negative or positive and will light one of two LED indicators.

When the receiver is tuned correctly both LEDs are off. Similarly, when receiver is tuned way off a station both LEDs are off. The LEDs merely provide a fine tuning indication when close to the station—they indicate the direction in which the fine tuning should be adjusted.

The remaining two op amps in the LM324N also function as a comparator, but monitoring the DC output of the in-phase synchronous detector. If the receiver is not tuned to a station, there is no DC component from the in-phase detector and the comparator will therefore mute the receiver by closing one of the CMOS switches (pins 1 and 2 of IC6) to short the input of IC5 to ground. As tuning approaches the station, VCO lock will occur and give rise to a DC component in the in phase detector output which will unmute the signal. This effectively eliminates the tuning whistles inherent in a synchrodyne receiver.

While the above system may appear to be effective, there is a problem when tuning away from a station. As detuning occurs, the PLL trys to follow until it loses lock and when it ultimately does, the DC from the in-phase detector disappears and the receiver is muted. Before the receiver is muted, loss of VCO lock must occur and if the muting circuitry is delayed in its operation (as it is by the RC filtering preceding D7) some whistles will be heard as detuning takes place.

To overcome this, the presence of current through the tuning indicator LEDs is monitored by Tr5 and Tr6 to produce a signal which is fed via diode D6 to also mute the receiver. So when the receiver is way out of tune, the lack of DC component from the in-phase detector causes the receiver to be muted; when it is almost in tune and once the tuning LEDs is alight, the receiver is still muted but by the latter mechanism.

Note the germanium diodes in parallel with the LEDs and base-emitter junctions of Tr5 and Tr6. Their function is to delay the turn-on point of the transistors, thus ensuring that the LEDs are well alight before the transistors turn on and hence mute the receiver. These diodes,

together with the base-emitter junctions of T5 and Tr6, also protect the LEDs from excessive reverse voltages. To overcome ambiguity when using the tuning indicator, it is desirable to ensure that when lock has been lost completely, e.g., when tuning in between stations, that the tuning indicator be made inoperative. This requires that the output of IC4 should be zero with respect to its input. Theoretically, this should automatically be the case, but device limitations prevent this. As the op-amp is in open loop condition as far as DC signals are concerned any small drift or offset, will readily cause railing of the output. One way of overcoming this is to reduce its gain. By placing R22 directly across the op-amp the gain is effectively reduced to about 5, ensuring that the output is always very near zero with respect to its input.

This gain switching is performed by one of the switches in IC6 and occurs automatically as the input to IC5 is muted. The gain reduction also effectively reduces the VCO pull-in range and as a result gives rapid tuning in.

Two final points about the IC6: The receiver is automatically muted during turn-on, and the switch associated with pin 5 allows the whistle filter to be made inoperative, if desired.

The power supply is quite straightforward and can use almost any small transformer with a 12V secondary. The regulator is a three-terminal type, 7812 as made by Fairchild or other manufacturers.

For the advanced hobbyist, construction is relatively straightforward. All circuitry is accommodated on the PC board.

Preset pot P1 is a miniature TO-18 type which may be a Helitrim 62P/5k as handled by Warburton Franki Pty Ltd, 199 Parramatta Road, Auburn, 2144. Alternatively, a Spectral 43P/502 may be used. These are distributed by Total Electronics, 69 Archer Street, Chatswood, 2067. The remaining trimpots are made by Piher and are in plentiful supply as are the plastic trimmer capacitors made by Philips.

IC2, SSS4016, is made by Solid State Scientific. IC6 should preferably be the Motorola Mc4016 because the switches have a lower "on" resistance than the SSS type. This is essential for efficient muting. SSS ICs are stocked by Cema (Distributors) Pty Ltd, 21 Chandos Street, Crows Nest, NSW.

The loop aerial consists of 25 turns of insulated hook-up wire wound on a suitable card so that the area enclosed by the loop is 30 x 70mm. Orient the loop for the best noise-free reception of the desired station.

The push-button permeability tuner module was a surplus unit obtained from Electronic Agencies, 115 Parramatta Road, Croydon South, NSW. Type number is 64600-029.

Because the oscillator coil must be rewound to enable it to operate at four times the received carrier frequency, it is necessary to rewind the other three coils so that they all track together.

Rewind using .004in enamelled copper wire for L1, L2 and L3. Starting from the rear end of the former close wind a single layer with the length of the winding equal to the slug length. This will give approximately 200 turns on each coil.

The oscillator coil requires 50 turns of litz wire evenly spaced out on the former with the length of the winding equal to the slug length. Uneven spacing will result in mistracking of the oscillator with the other tuned circuits. In some tuners, the oscillator coil former and slug may be different from the other three. If this is the case, a second tuner (which could be a manual unit) will have to be purchased and stripped of one of its coil formers and slugs.

The tuner module is attached to the PC board by suitably straightening the lugs on the rear of the unit and then soldering direct to the copper pattern of the PC board.

The whistle filter coil is wound on a Philips X22 cross core with 3H1 core material. 520 turns of 32 B&S enamelled copper wire are wound on to the bobbin. Type numbers of the various part numbers in the assembly are as follows:

3H1 core:	4322-020-23730
Adjuster:	4322-021-31080
Adjuster nut:	4322-021-30140
Coil former:	4322-021-31770
Metal can:	4322-021-30040
Cover:	4322-021-30230

In spite of the long type numbers, the coil assembly goes together in a logical way and is easy to make up. When installed and alignment is complete, the whistle filter can be adjusted for maximum null at 10kHz. Preset pot P3 must be adjusted in conjunction with the coil adjuster to give the best null. To enable this operation to be carried out, tune to a signal with 10kHz modulation and make adjustments while monitoring the residual 10kHz output.

Alignment of the receiver is fairly straightforward provided care is taken. Below are step by step instructions.

1. Set all trimmers and slugs to their mid position. Set P1, P2 and P3 to mid position and P4 fully anti-clockwise.
2. Shunt C3 with a 0.1uF capacitor.
3. Inject a 530kHz 10mV signal, modulated at about 50%, via a dummy antenna to the input. Set dial to low frequency end.
4. Adjust trimmers of L1, L2, and L3 to give max. reading at one of the collectors of the phase splitter ahead of the detector. Reduce the input signal if this exceeds 0.5 V P-P. Use a high impedance probe. Alternatively use a sensitive VTVM at the junction of the two AGC voltage doubler diodes D5, D6 and keep below 0.4V peak (between + 12V and junction).
5. Adjust trimmer of L4 to ensure proper lock-in, ie, tuning LEDs should be out, and a demodulated output signal should appear at the output of the receiver.
6. Set dial to high frequency end and adjust slugs of L1, L2 and L3 for max. output. Adjust slug of 14 for proper lock-in as before.

Note that this procedure is the reverse of that normally employed in a conventional set using a tuning gang. Normally, trimmers are adjusted at the high frequency end and slugs at the low frequency end.

7. Repeat until no improvement can be obtained. Remove shunting capacitor across C3.
8. If no sweep facilities are available, set generator to 600kHz and check bandwidth by deviating $\pm$10kHz about centre frequency. Adjust trimmer of L1 and L2 until symmetrically humped response is obtained. Go to 1400kHz and repeat. Go back to 600kHz and check. Readjust if necessary. Repeat until no improvement can be obtained. Ensure that at all times levels do not exceed 0.5V P-P. Do not touch slugs.
9. If sweep facilities are available, align trimmers as above. Signal level is not so critical here and may exceed AGC threshold. Use just AGC diode for a detector.
10. When alignment is complete, set signal level to about 50mV. Adjust P1 for min. envelope distortion. Increase or reduce signal level to give 5V P-P at collector of Tr2. Readjust P1 for min. distortion.
11. Set generator to 100% modulation and adjust P2 for min. distortion using distortion meter or CRO at AF output. Onset of distortion is quite positive. *(Continued on page 107)*

The Serviceman

You can't win 'em all!

Whenever one tends to become complacent about the servicing game, and maybe a trifle overconfident, there is always a fault waiting around the corner to cut you down to size; to emphasise, quite forcibly, that even the most classic symptoms can be misleading at times.

Such was the case with one of my most recent jobs. It was a fairly old 21in TV set which exhibited classic intermittent symptoms and caused several abortive service calls before I finally tracked down the fault.

The complaint was intermittent loss of picture and the first time I was called I quickly established that there was no raster and, in turn, no EHT supply.

On the basis of these symptoms I reckoned it was a fair bet that the horizontal oscillator, a 6BL8, was the culprit. Replacing it with a new one promptly restored the picture and, on the face of it, seemed to prove the point.

On the other hand, experience has taught me that such a clear cut cure can often be deceptive. Sometimes merely removing and replacing a valve will cure a fault; the fault being only vaguely associated with the valve. As a result, I make it habit to put the old valve back in in such cases and, every so often, I encounter a situation where the set, once disturbed, will continue to function with the old valve.

Such was the case on this occasion. On this basis I could hardly justify replacing the valve, or claim that this would cure the trouble. It was obviously a much more complex fault; probably a faulty capacitor which was being jolted back into operation by whatever surge resulted from changing the valve.

How to tackle it was the real problem. I didn't relish trying to track down an illusive intermittent on the lounge room floor but, at the same time, the customer wasn't too keen for me to take the set away, particularly when I warned him that tracking down a fault like that might take a week or more. Since the set was now working, he seemed willing to take a chance rather than miss out on his favourite serial.

In fact, I don't think he believed me when I warned him that the fault would recur. But it did, though I must admit that it was almost three months before I was called in again. This time I learned that it had failed on several occasions in recent weeks, then come good of its own accord. Well, at least the customer now understood the kind of fault he was up against.

This time I did no more than withdraw the 6BL8 and replace it, whereupon the picture appeared. Fortunately, I had another job to do in the vicinity, so I told the owner to leave the set running and that I would come back in about an hour. When I did the set had failed again and this time I simply went over the chassis with a screwdriver, prodding and tapping in the hope that I would disturb something.

I could find nothing and was on the point of giving it away when I idly touched the blade of the screwdriver on the plate cap of 6CM5 line output valve. Immediately, the set came good. Since I hadn't touched the cap hard enough to jolt anything, I was convinced that I had created a small electrical surge which had jolted the faulty component back into operation.

Unfortunately, apart from confirming my suspicions about an intermittent capacitor, this discovery did little to help. Once again I explained to the customer that the fault was not the kind I liked to tackle in the customer's home; it needed to be tackled on the bench, and it might take some time. The alternative was to simply let the set limp along as it had been in the hope that the faulty component would fail completely, thus putting the question beyond doubt.

Still the customer hesitated. He had apparently been watching me when I touched the plate cap with the screwdriver blade, and suggested that he might be able to keep the set going by using the same trick. I told him I could not guarantee that the trick would work every time but, it he wanted to try the idea, he was welcome. Naturally, I warned him about the high voltage on this terminal and emphasised the need to use an insulated screwdriver.

In fact, as I was to learn later, this trick proved most reliable and he used it repeatedly over the next few months. But then came the day when it failed and, after a couple of days of futile attempts to get the set working he called me. And this time it was he who suggested that I take the set away and keep it until it was fixed.

With the set on the bench I first gave it a quick once over with the voltmeter, which revealed that HT voltage was about 25 to 30 volts lower than it should have been for this set. I went immediately to the rectifier, a pair of 6N3 half wave rectifiers in a conventional full wave circuit.

Replacing them restored the full HT voltage, but did nothing to restore the picture. A quick check confirmed that there was no signal at the grid of the line output valve, once again throwing suspicion on the line oscillator stage. Even though I had done it several times before, I tried a new 6BL8. And presto! Up came the picture.

Naturally, I didn't take too much notice of this. I assumed that, as before, I would be able to plug the old valve back in and the set would still work. But it didn't. What's more, a few minutes spent swapping the two valves backwards and forwards, plus several other new valves convinced me that the old valve really was faulty.

Suddenly, I had a horrible feeling that I had tricked myself; that there was no intermittent fault in the set other than a sick 6BL8, aided and abetted by a pair of groggy 6N3s. Subsequently this was confirmed by a lengthy test run.

With the benefit of hindsight I began to piece together what had really happened. The 6BL8 is a rather notorious valve for dropping out of oscillation when it gets a bit long in the tooth, particularly when operated at less than normal voltage. In fact, it commonly shows up as a fault which occurs quite regularly during the evening peak load when line voltage, particularly on long runs, tends to drop.

There had been no such pattern in this case—it might have helped if there had been—but this was not the real reason I had been deceived. What had tricked me was the fact that, on every occasion, I could restore performance by simply removing the valve and replacing it.

Exactly why it behaved like this is rather difficult to explain. I can only suggest that the valve's performance was quite marginal; so much so that it was only just making the grade on the reduced HT voltage.

Assuming a drop in line voltage it would probably go out of oscillation, then refuse to start even if the line voltage was restored. But apparently the balance was so delicate that almost any kind of a disturbance in the set was sufficient to start it again. Even, it would seem, replacing the valve in its socket after the heater had had time to cool.

Don't ask me why, I only know it happened

One other factor may have been significant. The customer lived in the centre of a shopping area and there was some suggestion that the daytime power load was greater than the evening load. In any case, it was a fact that the set only ever failed during the day, never in the evening or at night.

So, in fact, I could have cured the problem in the customer's home simply by replacing the three valves, had I not been tricked into believing that I had a classic intermittent fault on my hands. Ah well, you can't win 'em all!

Mention of 6N3s in that last story reminded me of a typical fault which they exhibit and which, the first time I struck it, sent me on a wild goose chase.

The complaint was a completely dead set due, in turn, to a blown main fuse. When this was replaced one of the 6N3s became very red in the face.

Diagnosing an HT short I spent several fruitless minutes trying to track it down, only to finish up back where I started, at the 6N3s, one of which turned out to have a plate to cathode short. Needless to say, I haven't been caught by that one since.

This next case was a classic example of a fairly routine type of fault which I have encountered over the last couple of years, but which I don't think I have ever mentioned in these notes before. It is also a very good example of how a serviceman can help his customers by simply being on the lookout for those faults which creep up so slowly that the customer is seldom aware of them.

In fact, the customer seldom complains about this fault; the set is invariably brought in for some other, more obvious, trouble. The sets in question are fairly old—anything from 10 years upwards—and the fault is a general degradation of picture quality; mainly lack of contrast.

The first time I encountered this I must confess I wrote it off as a dying picture tube, with the reservation that it was probably good for some time yet provided the customer was happy with the picture—or, at any rate, happy enough not to want to spend a substantial sum on a new tube.

Later, I wondered whether this was an accurate diagnosis and, the next time I encountered a set with these symptoms, I delved a little deeper. The result was a routine check which I now apply to any set of this age which exhibits other than a first class picture.

As I said, this latest one was a classic example. It had come in for a quite different fault which was soon disposed of. Then I studied the picture. Yes, it was quite wishy washy by normal standards, and there was also some evidence of streaking; something which was hardly likely to be a picture tube fault.

First I patched the set across to a test picture tube which I had available on the bench, and which should have given a first class picture. In fact, it was just as wishy washy on this tube as the old one.

Thus encouraged, I attacked the video amplifier stage. The valve was a 6AQ5 and I immediately replaced it. The difference in contrast was literally staggering, clear proof that the old valve was sick.

But the streaking remained. In this particular set the contrast control is in the cathode of the 6AQ5, consisting of a 1.5k variable resistor connected to the cathode and in series with a 560 ohm resistor connected to chassis. This latter resistor functions as a conventional bias resistor and is bypassed with a 25uF capacitor.

This capacitor was the culprit. Apparently it had lost some, but not all, of its capacitance thus effectively attenuating the low frequency response. Replacing it produced a similar dramatic improvement in the picture.

The end result was a "like new" performance from what had appeared to be a tired old set waiting to be pensioned off. And the effect on the customer was no less dramatic. I should be used to the "It's better than new" reaction which invariably accompanies such a marked improvement in any piece of equipment, but the truth is I still get a lot of satisfaction from such enthusiasm. What's more, I know I have gained a lifetime customer, plus a flattering recommendation to friends and relations.

So, next time you handle an old set, take a good look at the picture and see if it needs a bit of a boost. It may only need a simple check of the video stage, but the results can be very rewarding.

Teaching your EDUC-8 to play a melody

As a change from the more conventional peripheral units so far described as part of the EDUC-8 system, the author here describes a "music player" output device. Producing musical notes which are under program control in terms of pitch, octave and duration, it may be used either purely for demonstration purposes, or to form the foundation of a digital music synthesiser system.

by JAMIESON ROWE

At this stage, having described a number of input and output peripheral devices of the conventional "computer attachment" variety, it seems appropriate to describe something rather less so. If nothing else, I hope this will perhaps start to show you that there is a whole area of largely unthought-of computer applications and interfacing possibilities, which is wide open for you to explore.

The device I have chosen to do this is a "music player" output device, which is capable of producing a monophonic melody under the direction of a suitable program in EDUC-8. While only a simple device, it provides program control of note pitch, octave and duration, and thus allows the computer to play tunes in quite a convincing manner.

As it stands, it is just the thing for demonstrating the EDUC-8 system to non technical people. Such people generally don't find the more conventional peripherals and functions of the computer very impressive, perhaps because it isn't easy for them to visualise just what is involved. But plug in the music player, feed in a simple tune playing program, and their eyes soon light up when the system starts playing "Greensleeves", or some other familiar tune—with no revolving record, unwinding tape, or other moving parts!

If you wish, however, it could be used as the start of a more elaborate arrangement. By adding facilities for programmable attenuation, filtering and so on, it could well be expanded into a digital music synthesiser system. The potential seems to be there for quite a lot of development work along these lines, if you find the idea of digital music synthesis interesting.

Whether you intend building it up purely as a simple music player or as the start of a more complex synthesiser, I think you'll find the device well worth constructing. And good fun, too!

At the heart of the device is one of the new MOS LSI top-octave note frequency synthesiser ICs, which takes an input signal at the lowest common multiple frequency, and simultaneously performs all of the frequency divisions necessary to produce the 12 notes of the "even-temperament" musical octave.

There are two almost identical devices of this type currently available, either of which may be used in the player. One is the type AY-5-0212, made by General Instrument Microelectronics, and the other is the MK50242, made by Mostek Corporation. These are functionally equivalent, the only difference being that the latter operates from a single +12V supply rail whereas the former requires a —12V rail as well. The GIM chip is available on order from General Electronic Services, while the Mostek chip may be ordered from Total Electronics.

Whichever chip is used, in this circuit it is fed with an input signal at very close to 500kHz. As a result the 12 locked semitone outputs produced correspond to the octave beginning with the third C-sharp above middle C—i.e., the octave with A equal to 1760Hz. These notes are then fed to four cascaded binary dividers, so that the actual output pitch range of the player unit covers the four octaves below this initially synthesised octave. In other words, the player produces output notes extending for two octaves either side of middle C.

In electronic organs, for which these top octave synthesiser chips are primarily intended, the input reference signal is generally derived from a crystal oscillator. This gives an appropriately high order of absolute pitch accuracy, as well as high stability. However for the present application a crystal oscillator has not been used, as high accuracy and stability are scarcely necessary.

Note, by the way, that we are talking here of absolute pitch accuracy and stability, not relative pitch accuracy. The intervals between the notes are automatically locked by the IC; it is only the absolute pitch of all the notes as a whole which can be varied.

As you can see from the circuit diagram, the oscillator used to generate the 500kHz signal is a simple R-C oscillator using half a 7413 Schmitt trigger device. This feeds the note synthesiser chip via a logic level converter stage using a BC108 or similar transistor. The oscillator frequency may be adjusted using the 25k pot, which thus becomes the "absolute pitch" tuning control for the player.

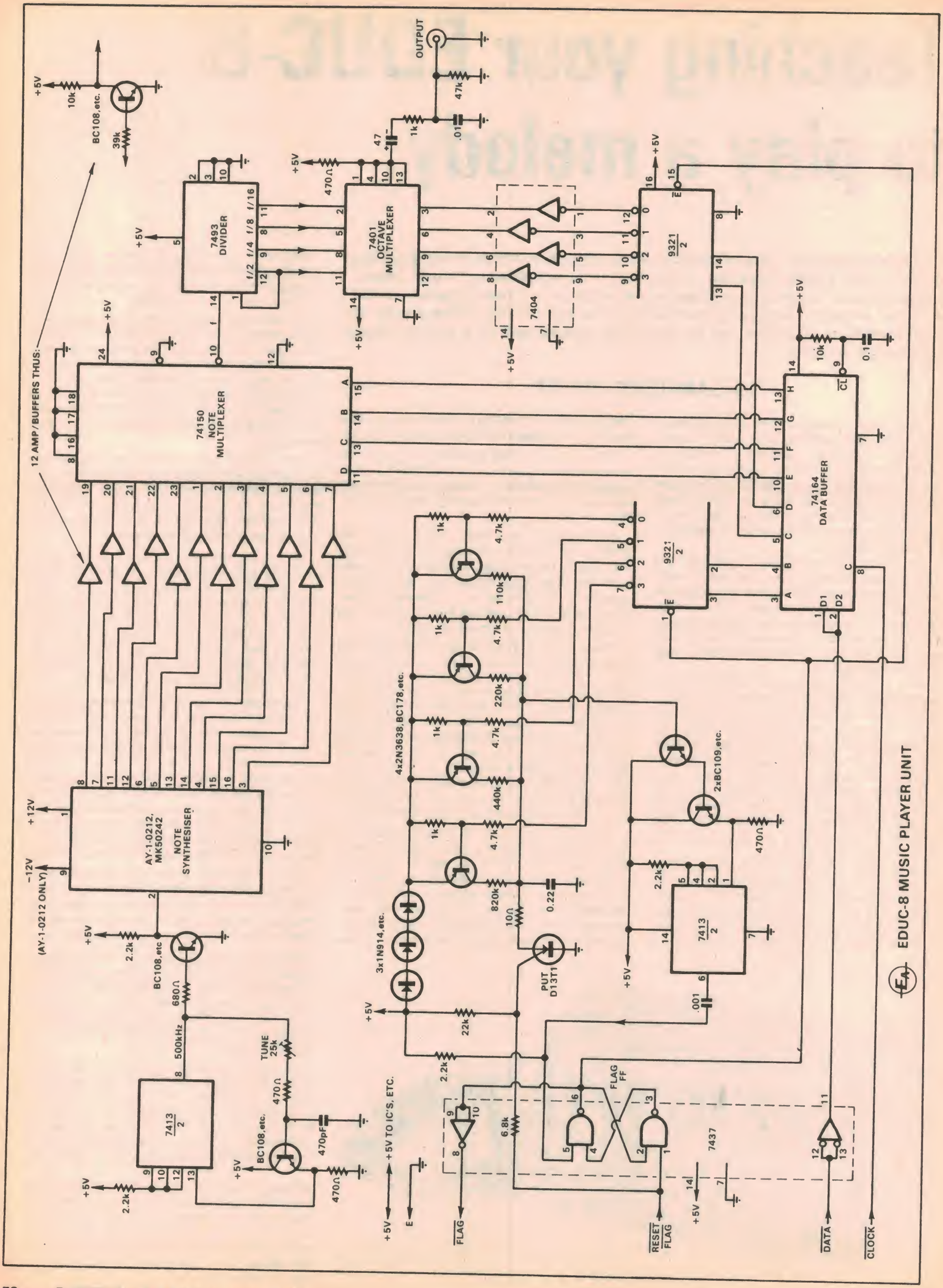
Strictly the exact oscillator frequency required will depend upon the absolute pitch reference used, because the IC division ratios used to give the various note intervals are only 3-digit approximations. Thus if you use A = 440Hz as the pitch reference, the correct oscillator frequency will be 499.840kHz, but if you use C = 261Hz, the correct oscillator frequency will be 499.032kHz. As you can see the differences are rather academic, and 500kHz is probably quite close enough for most purposes.

The 12 outputs of the note synthesiser IC are each provided with a buffer stage, using a BC108 or similar NPN transistor. This is again for logic level conversion, so that the signals may be fed to the TTL note multiplexer.

The note multiplexer is a 74150 device, which in effect forms a digitally programmable 16-position switch. Only one of its 16 inputs may be connected to the output at any one time, and the particular input selected is determined by the logic levels applied to the "address" inputs A, B, C and D.

As these inputs are connected in turn to the H, G, F and E outputs of the 74164 data buffer register, respectively, this means that the four least significant bits of the 8-bit number fed to the player from the computer provide the "instruction" to the note multiplexer. Each of the 16 possible combinations of these four bits

Perhaps it doesn't look much like a music box, but hook it up to your EDUC-8 and an amplifier and it will play almost any tune you care to encode. This prototype was built up in a small utility case, with the ICs mainly on one of the EA "Multi-DIP" PC boards. The full logic diagram is shown overleaf.



EDUC-8 MUSIC PLAYER UNIT

will force the 74150 device to connect the corresponding input to its output.

There are only 12 signals to be multiplexed, in this case, so that four of the 16 combinations provided by the 74150 are not used. These are 0000, 1101, 1110 and 1111, corresponding to octal 00, 15, 16 and 17. If specified by the computer data word, all four combinations produce silence, or a musical rest.

The 12 address combinations corresponding to octal numbers 01-14 inclusive are used for the active notes. The coding used is in simple progression, i.e., C-sharp is octal 01, D is 02, D-sharp: 03, and so on up to C: 14.

The output of the 74150 note multiplexer is fed to a 7493 binary divider, which consists of four flip-flops connected in cascade. Thus the selected note frequency is divided by 2, 4, 8 and 16, with signals at the appropriate sub-multiple frequencies available at the four device outputs. The four 7493 outputs thus effectively provide the selected note, but in each of four octaves.

To select which octave is required, a 7401 quad 2-input gate is used to produce a simple 1-of-4 multiplexer. The four open-collector outputs of the 7401 are connected together, with a single 470-ohm output load. This forms a wired-OR configuration, so that any one of the four gates can feed the output.

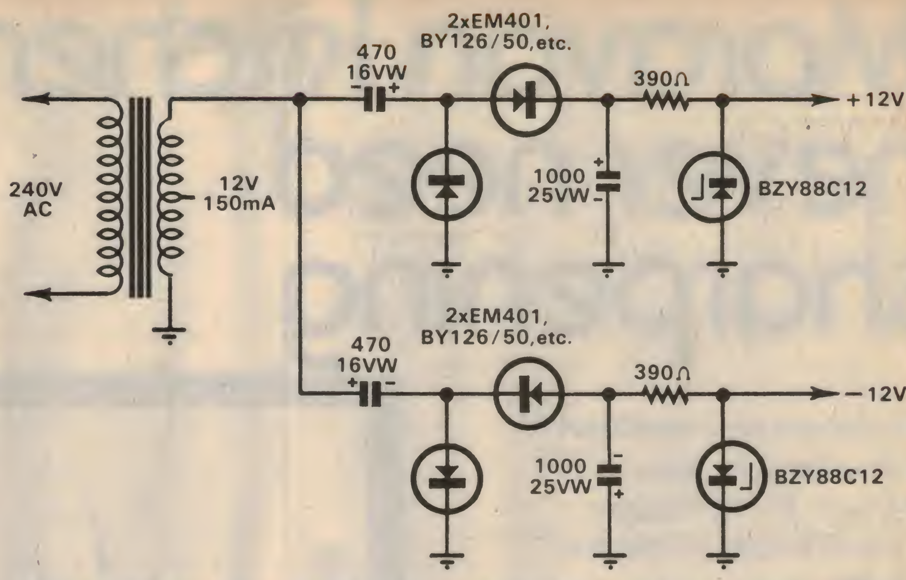
Gating signals for this simple octave multiplexer are derived from outputs C and D of the data buffer register, via half of a 9321 dual decoder device. Each half of the 9321 is a 2-bit decoder, with active low outputs. For each half of the device, only one of the four outputs can be low at any one time, and the output concerned depends upon the state of the two input bits. Thus the input bit combination 00 causes output 0 to go low, while input combinations 01, 10 and 11 cause outputs 1, 2 and 3 to go low respectively. Each half of the 9321 has a separate enable (L) input, which must be low before any output can go low.

As the 9321 device has active low outputs, and the 7401 device used as the octave multiplexer requires active high selection signals, a 7404 device is used for inversion. The two "left over" inverters in the 7404 are not used in the present player circuit, and could be used for other things if desired.

The output of the 7401 becomes the audio output of the music player, and is fed to an output socket via a simple R-C shaping circuit to provide a moderate amount of smoothing. This helps remove switching transients, and helps to make the square-wave signal a little less "harsh".

The audio output signal is of about 3V peak-to-peak, and has a source impedance of about 1k. You can therefore feed it into almost any audio amplifier, via the "radio" or "auxiliary" inputs.

At this stage, it should be fairly clear that the circuitry so far described is capable of taking the six least significant bits of a data number fed to the player from the computer, and using them to select and play any one of the 12 musical notes, in one of 4 octaves. Thus, for example, octal 22 will result in the sounding of the D in the second lowest octave, while octal 67 will produce the G of the topmost octave.



A simple power supply circuit for the music player device, to provide the supply voltages not available from the computer itself. Note that the -12V section is only required for the AY-1-0212 chip, and may be omitted for the Mostek MK50242.

The remaining circuitry of the player device has been provided to automatically time the duration of notes. Four programmable note durations are provided, controlled by the remaining two bits of the data word—available at outputs A and B of the 74164 data buffer register.

The way in which the two control bits are used to control note duration is by having them determine the delay period of a simple timing circuit, used to set the flag flip-flop after the latter has been initially reset by the computer following delivery of the data word. By connecting the enable (L) input of the 9321 decoder feeding the octave multiplexer to the flag FF, this means that the note produced by the player only lasts for the interval between resetting of the flag FF by the computer, and the subsequent setting by the timer, after the programmed delay.

The timing circuit is basically the same as that used in the simple octal display unit, described earlier. It uses a D13T1 programmable unijunction or PUT to discharge a capacitor, when triggered by the flag reset signal. The capacitor is then allowed to charge, and when it reaches a certain charge level a flag setting pulse is produced by a level detector circuit. The level detector uses two BC 109 transistors, feeding the other half of the 7413 Schmitt trigger device.

The delay time is programmed by using four PNP transistors to switch in four different values of charging resistance. The transistors may be type 2N3638, BC178, BC327 or similar, and they are controlled by the four outputs of the second half of the 9321 decoder device, connected in turn to the A and B outputs of the data buffer.

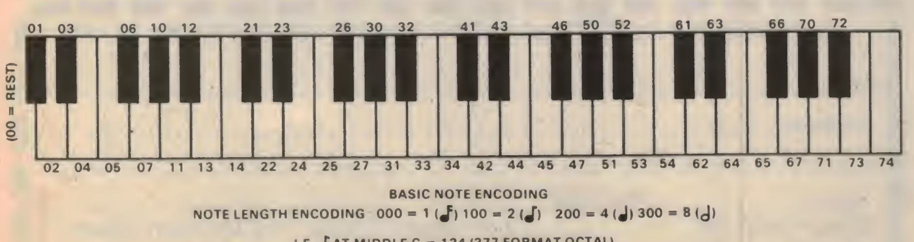
The four timing resistors have values which vary in binary ratio, so that each gives a delay time and note duration twice as long as its successor. Thus if the two most significant bits of the data word are both zero (octal 0--), the resulting note duration will be of say one unit long. If the less significant bit is 1 (octal 1--) the note will last for 2 units of time, while if the more significant bit is 1 (octal 2--) the note will last for 4 time units. Finally if both bits are 1 (octal 3--) the note will last for 8 time units.

The binary time ratios have been provided not because of some slavish desire to "keep everything binary", but merely because this is the normal relationship used in music. Thus octal 3-- could correspond to a minim or half-note, octal 2-- to a crotchet or quarter-note, octal 1-- to a quaver or eighth-note, and octal 0-- to a semiquaver, or sixteenth-note.

Naturally the correspondence between the binary-octal coding and the various notes will depend upon the actual delay time and the musical tempo. By varying the timing capacitor, shown on the circuit as 0.22uF, you can adjust the relationship at will. Larger capacitor values will give a slower tempo, or longer note values for the same tempo, while smaller capacitor values will give either a faster tempo or shorter note values.

You could provide a number of capacitor values, selected by a manual switch on the player, if you wish. Ideally the values should be in binary ratio, so that you could start with values of 0.1uF and 0.47uF in addition to the existing 0.22uF.

To recapitulate, then, the music player unit operates as follows. To play a note, the computer must send an appropriately coded data word into the player's data buffer register. The four least signficant bits of the word cause the 74150 note multiplexer to select the desired note, while the next two bits are applied to the octave multiplexer half of the 9321 decoder, ready to select the octave in which the note



Using this note encoding guide, you should find it fairly easy to encode any desired tune for playing by the device. Note that the final code for a note is formed by adding the basic note code to the desired duration code, as shown by the example.

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is to be played.

The computer must then reset the flag FF, which enables the 9321 decoder, and this in turn enables the octave multiplexer to begin sounding the note. At the same time the D13T1 PUT in the timing circuit is triggered, discharging the timing capacitor. The second half of the 9321 decoder is also enabled, turning on one of the four timing resistor switching transistors according to the coding of the two most significant data word bits.

When the timing capacitor recharges, after the appropriate period of time, the level detector circuit sets the flag FF once more, disabling the 9321 decoder and hence causing the note to end. At the same time, the flag line of the player goes low, indicating to the computer that the note has been played. The computer may then send another note, if this is appropriate, to repeat the cycle.

Note that the player may be arranged to play "rests", or periods of silence, by feeding it words whose note coding corresponds to one of the four unused note multiplexer addresses. The duration of the rest may be programmed just as with normal notes, by using the two most significant bits. Thus octal code 100 will produce a rest of 2 time units duration, while code 300 will produce a rest 8 units long.

Note also that the 74164 data buffer register is fitted with an R-C circuit connected to the clear (L) input. This is to reset the register when power is first applied to the player, so that it doesn't burst into spontaneous song!

Most of the ICs in the music player are of the TTL type, and are powered from the 5V supply of the computer, via the connection cable. The only exception is the note synthesiser chip, where both of the alternative ICs require +12V, with the AY-1-0212 requiring −12V as well. To provide these voltages the player includes a small power supply, whose circuit is shown in the small diagram.

The current drain from the +12V rail is only about 20-25mA, while that for the −12V rail is even lower—around 4mA. As a result the power supply is very straightforward, using a miniature 12V/150mA transformer such as the Ferguson type PF2851 or similar. Two half-wave voltage doubling rectifiers are used, with simple zener diode shunt regulators. Note that the −12V part of the supply may be omitted if the Mostek 50242 note synthesiser chip is used.

I built up the prototype player unit in a small utility box, of the type used for small stereo amplifiers, etc. Most of the components and wiring were mounted on one of the EA "Multi-dip" boards, which are very suitable for this sort of one-off project using a number of ICs.

The only parts of the circuit not mounted on the Multi-dip board were the note synthesiser IC with its thirteen transistor buffer stages and power supplies and the power transformer. The latter was simply mounted in the case near the rear, with its primary connections taken to a B-B connector strip to mate with the mains cord wires in the approved manner.

To mount the note synthesiser chip, its buffers and power supplies conveniently, I used one of the PC boards originally designed for the "Crystal Locked Musical Tone Generator", described in the August 1974 issue of Electronics Australia. The board is coded EA 74/09, and was designed to take the chip and buffers, as well as power supply circuitry. Although the present voltage-doubler rectifiers are a little different from those used in the original project, the power supply wiring can still be fitted on the PC board quite easily.

To give you an idea of the programming required for the music player, I have reproduced here a simple tune-playing program which wil play a sequence of notes, automatically spaced by rests. Each rest is equal in duration to the note which immediately precedes it, a simple arrangement which gives a fairly natural sound to most tunes.

The coding for the tune to be played must be stored along with the program in the memory of the computer, beginning at location 030 octal. The tune can occupy the entire remainder of the memory, which forms the "tune buffer" area. As this comprises some 347 octal or 232 decimal locations, the program can play quite lengthy tunes. (Only the actual notes of the tune are stored, the program itself inserting the spacing rests.)

You can make the program play the notes of a tune without the spacing rests by replacing the instructions in locations 15, 16 and 17 (octal) with "NOP" instructions (octal 700). This will give a "legato" effect, which can be more appropriate with some tunes.

This is a very simple program, and you will no doubt want to try your hand at a more elaborate effort later on. But this one should at least serve to get your music player going.

To help you in encoding tunes for the player, we have prepared a diagram which shows the notes laid out in piano keyboard fashion, with their corresponding coding alongside. The note length encoding is also shown beneath; this is added to the note encoding to form the complete code number for each note. Hence if you want a note to be middle C, and to last for 2 units of time, the coding is 100 + 34, or 134.

EA EDUC-8 PROGRAM — MUSIC PLAYER SA=Ø1Ø (LESS TUNE)

STEP	MNEMONIC	CODE
0	PLAY,Ø	ØØØ
1	LMB	626
2	SMF	621
3	JMP .-1	5Ø2
4	JMP I PLAY	52Ø
5	INDY,Ø	ØØØ
6	BUFS,Ø3Ø	Ø3Ø
7	MASK,3ØØ /377 format	6ØØ
10	STRT,CLA	71Ø
11	TAD BUFS	1Ø6
12	DCA INDY	3Ø5
13	GO,TAD I INDY	125
14	JMS PLAY	4ØØ
15	TAD I INDY	125
16	AND MASK	ØØ7
17	JMS PLAY	4ØØ
20	ISZ I INDA	226
21	JMP I GOAD	525
22	HLT	721
23	JMP I STTA	524
24	STTA,Ø1Ø	Ø1Ø
25	GOAD,Ø13	Ø13
26	INDA,ØØ5	ØØ5
27		
30	(start of tune buffer)	
31	....	
32	....	
33	....	
34		
35		
36		
37		

This simple program will play tunes with each note followed by a rest of the same duration. The notes of the tune are stored in memory along with the program, beginning at location 030 (octal).

Note that the octal format assumed by the note encoding diagram is "377" format, which is fairly obviously the more appropriate in view of the way in which the player interprets the 8-bit words fed to it.

So that you won't have to work out the encoding of a tune before you can get your player working, here is the coding for the familiar tune "Greensleeves". It is in 377 format octal, with bars separated by semicolons: 224; 327, 231, 233, 134, 233; 331, 226, 222, 124, 226; 327, 224, 224, 122, 224; 326, 222, 313, 224; 327, 231, 233, 134, 233; 331, 226, 222, 124, 226; 227, 126, 224, 223, 121, 223; 324, 224, 324, 200; 342, 242, 141, 233; 331, 226, 222, 124, 226; 327, 224, 224, 122, 224; 326, 222, 313, 200; 342, 242, 141, 233; 331, 226, 222, 124, 226; 227, 126, 224, 223, 121, 223; 324, 324, 200; 300, 300, 300,. . . The code 300s at the end are simply to give silence after the tune ends, for better effect.

I suggest that you punch this coding onto paper tape, using a modified version of the program given earlier for program tape punching from the keyboard unit. Modify the program so that it will accept the octal input digits in 377 format, instead of the 737 format used for program encoding.

If you start this and all subsequent tune tapes with an "end of leader" bit code, followed by code 030, they can be loaded into the computer tune buffer at any time, without disturbing the tune playing program itself. This way, you can change tunes at will, without having to load in the program itself each time.

Incidentally, if you load in the tune playing program without an intentional tune, and set it going, it will "play" whatever random numbers are already in the computer's memory—either the remains of earlier programs, or the turn-on bias bits of the memory RAM flip-flops if you have just turned on. Either way, the sounds produced can be quite weird!

Well, that's the basic music player device, which will let your EDUC-8 play a simple tune. It's fairly straightforward, as you can see, and leaves plenty of room for elaboration should you be so inclined.

One idea would be to build a companion unit, which would take the raw audio output from the player and put it through a programmable attenuator and filter system, to vary both amplitude and harmonic content under the control of a second 8-bit word. Three of the bits could be used to give eight different amplitude levels, say, while the remaining five could be used to control the characteristics of a programmable formant filter.

For the attenuator you could use three NPN transistor switches, driven from the three appropriate outputs of the data buffer register, and switching the shunt resistors in a ladder-type resistive attenuator circuit. The filter scheme could be implemented in a similar way, with the transistors effectively switching high or low-pass filter sections in and out of the signal path. The whole unit might involve say a 74164 for the data buffer, eight BC108 or similar transistors, and some R's and C's.

Another idea would be to expand the player itself, with additional data buffers, so that it could play a number of notes at once—for chords. The data words from the computer could be directed to the various buffers using a simple multiplexer scheme.

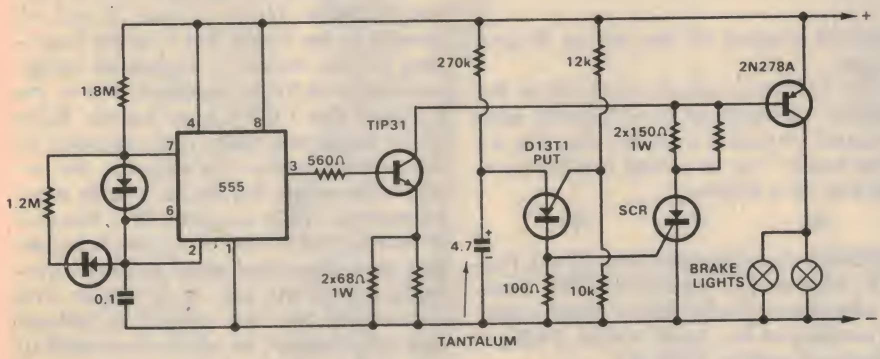
No doubt other ideas along these lines will occur to you as you go along. Have fun!

Circuit & Design Ideas

Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

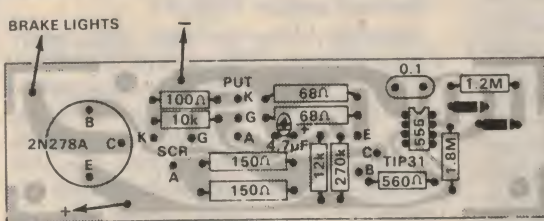
Brake light pulser uses 555 chip



Here is yet another application for the 555 IC timer. The thought occurred to me recently that it would be possible for the driver of a motor vehicle to fail to observe the onset of brake lights of the vehicle immediately in front. This could occur if the driver blinked or was otherwise distracted from the brake light area of the other vehicle. The lights having come on in the interim may be wrongly interpreted as tail lights and so the significance of the braking has been missed. This could lead to a possible embarrassing situation.

To avoid this situation, I have developed a circuit which causes the brake lights to flash four or five times immediately after being operated each time. This would alert the following driver. After flashing the brake lights remain on normally, until the brake pedal is released.

When the brake light circuit is actuated, the 555 timer begins operating and initially flashes the brake lights via the two bipolar transistors. Meanwhile, the 4.7uF capacitor begins to charge in the PUT circuit. When the capacitor is



At upper left is the circuit for the brake lamp flasher, with the actual size pattern for the PC board at right. Above is the board wiring diagram.

fully charged, the SCR is fired and this condition turns on the last transistor, thus overriding the effect of the signal from the 555 timer.

The circuit as shown is relatively simple and easy to make. If you have the facilities, you could make up a printed board. Alternatively, it could be made up on a piece of Veroboard or tagstrip and preferably mounted in a protective metal box. The assembly may be mounted immediately behind one of the brake lights in the boot of the car.

(By Mr A. Beekman, 13 Emu Street, Enfield, NSW 2136.)

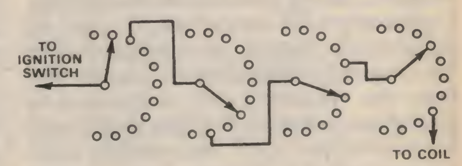
Simple combination lock for cars

This simple electrical combination lock using two or more 11 or 12-position rotary switches is not new, having been developed in the mid 1940's by a British engineer, G. W. Smiles. However readers may be interested in the idea of using it as an anti-theft device in the ignition circuit of a car. Providing the wiring is protected from ready access and jumpering, it should prove quite effective.

The basic idea is to wire the switches in series, as shown, with the wiring such that each switch must be in a certain position before the next receives current. The switches are inserted in the ignition circuit, between the normal ignition switch and the live coil terminal.

The more switches are used, the lower the chance that a thief will hit upon the correct combination. Two switches give odds of 143:1 against, three 1727:1 against, and four switches an impressive 20,735:1 against (assuming 12-position switches).

The system can be made more effective, in terms of protection, if all of the unused switch positions are wired in parallel and used to trigger off a horn



activating circuit. Then if the thief tries any of the wrong combinations, his error will be signalled by a blast on the horn, perhaps pulsed on and off for more attention.

(By W. A. Gold, 7/29 Dominion Circuit, Forrest, A.C.T. 2603.)

Classical Recordings

Reviewed by Julian Russell

Mozart—"enchanting production"

MOZART—Serenades. Vol. 1. Serenade No. 4 in D (K.203). Horn Rondo (K.371). Vienna Mozart Ensemble conducted by Willi Boskovsky. World Record Club Stereo No. S/ 5220.

Mozart's Serenades were not songs to be sung under a loved one's window but extended works running into many movements. In this one, "The Colloredo", there are eight. And the second, third and fourth movements contain what amounts to a three movement violin concerto. The ornamentation throughout the whole work is elegant and unanimous, the phrasing a delight. Those who were encouraged to buy at least one of the large issue (10 discs) of Mozart's Marches and Dances will be no strangers to the virtues of Willi Boskovsky's Vienna Mozart Ensemble which performed them with consistent excellence. In the Serenades—this is Volume 1—the players have much more varied material to work on and this they do with admirable sensitivity. Everything is deliciously sweet yet nothing ever cloys.

The players are all hand picked from the great Vienna Philharmonic Orchestra. I much prefer Boskovsky's handling of a more or less chamber group to his performances with larger combinations during his recent Australian tour, though there was very little to complain about in those live performances. In the Colloredo he pays scrupulous attention to balance so that important passages—and counter themes—are always comfortably audible. The original recording, by the way, was made in 1967 and is first class even judged by the most sophisticated of modern standards. If I have to choose one minor disappointment in this otherwise enchanting production it would be a preference for more weight given to the intricate figured accompaniment to the oboe solo in the sixth movement. But then the whole of this movement is played so delicately that this might well have interfered with the carefully considered balance. Perhaps it is a matter of the tempo being just that trifle too fast to allow this part of the score to expand and blossom. A special word of praise for the anonymous solo oboist, the solo violin of Alfred Starr, and in the Horn Rondo that makes an attractive fill, the splendid playing of the soloist Roland Berger.

The Colloredo got its name from the odious Archbishop of Saltzburg who treated Mozart and his family so abominably. He deserved much less in the way of a tribute.

* * *

MOZART—Symphonies Nos. 39 in E Flat (K. 543) and G Minor (K. 550). Concertgebouw Orchestra of Amsterdam conducted by Josef Krips. Philips Stereo Cassette 7300 271.

Although I have for many years been a great admirer of the recently deceased Josef Krips I must confess to disappointment at having to write that in these works he shows his inferiority to Bohm as a Mozart conductor. Nor can the splendid Concertgebouw Orchestra be blamed for his failings. These are not immediately apparent in the wide solemnity of the introduction to the E Flat, supported as it is by the superb quality of the recording. But the following allegro may sound a little too leisurely to those accustomed to the faster customary tempo. Yet, despite Krips' pace, he wins considerable spirit from the orchestra whose playing is always full of affectionate dynamic contrasts. Krips maintains this same leisurely Viennese atmosphere in the slow movement which, too, is not without its own charm and receives its full measure of discrimination in its later, darker moods.

But overall the reading is just a trifle too amiable. There is, too, a lack of sparkle in the Finale. But if, at the beginning of this review, I expressed disappointment in Krips' readings, it is in the G Minor that I felt it most keenly. Right at the beginning there is an absence of the sinister quality one expects, the energy with which the music is at its most expressive. Most importantly I listened in vain for the mood of agitated despair that most musicians associate with Mozart's use of the key of G Minor. The phrasing of the first subject is without dramatic interest, of which there should be plenty, nor do the heavy contrasts between the loud and soft passages provide it. The inside movements easily pass muster but the same first movement style is repeated in the Finale. However I freely admit that the truly wonderful quality of the engineering might well rule out my objections in the opinion of a considerable number of buyers.

Williamson & Banks—two Australian composers

WILLIAMSON—The Display. Ballet Suite. Sydney Symphony Orchestra conducted by John Hopkins.
BANKS—Violin Concerto. Leonard Dommett (violin) with the Melbourne Symphony Orchestra conducted by Patrick Thomas. World Record Club Stereo WRC S/5264.

Only few ballets survive dissociation from the theatre. There are, of course, all Tchaikovsky's, early Stravinsky's—Firebird, Petruchka and Sacre, for instance—and occasionally Apollo. The rest are in limbo, as are pretty well all the many excellent scores commissioned by Serge Diaghileff during the late 1919s and 20s. Have you ever heard recently Le Pas d'Acier of Prokofieff, Les Biches by Poulenc, or many other of that period too numerous to mention. Only Falla's Three Cornered Hat and Amor Brujo have made it. Now while Williamson's score made a useful contribution to the success of Helpmann's ballet, The Display, it by no means shows this very versatile composer at his best. Listening to it nowadays one needs the action—or at any rate a very good memory of it—to make much impression. True, a good precis of the ballet is given in the sleeve notes but even these will provide scanty clues about what is going on to those who never saw the ballet.

The recording is not of the complete ballet but a well-knit suite using its main movements. It is picturesquely illustrative in style with bird songs, bush sounds and a vigorous invasion of the quiet scene by brawling, boozing teenagers. The score might be best described as eclectic. Williamson can write in many styles and doesn't hesitate to do so. If there is not an unpleasant bar in The Display, there are not many memorable ones either. And the best of these usually owe allegiance to one of Williamson's forerunners. Even the long legato tune on the violins is reminiscent of much music composed in the 1920s. But many who remember the ballet might well find it has much nostalgic appeal. It is very well played by the Sydney Symphony Orchestra under John Hopkins and recorded a little on the resonant side.

Don Banks—both composers on this disc are Australian—is also an eclectic writer who has interested himself in many musical media, including jazz. The concerto was commissioned by the BBC for the London Promenade Concerts and had its first performance in the Albert Hall in 1968. It opens, states Banks him-

self in the sleeve notes, with the solo instrument playing a sustained D, changing colour between open and stopped strings. Just how far Banks expected such a subtle change of timbre to carry in the vast spaces of the Albert Hall is a matter for speculation. But at any rate it was an idea, and I suppose worthy of notice in these days when novelty is mistaken for musical merit. Much of the work has about it that quality of anonymity so distressingly common among many avant garde composers. Their works are often as alike as the jeans they probably wear. There are, of course, some who claim that this kind of music moves them. It moves me too—towards the closest exit! By the way, a five line paragraph is repeated in the sleeve notes no doubt due to gremlins in the composing room—pun intended. It is excellently played and recorded by all concerned.

★ ★ ★

HAYDN—Symphonies No. 94 (Surprise) and No. 101 (Clock). NBC Orchestra conducted by Arturo Toscanini. RCA Victrola Mono VVM1-7005.

The quality of the sound in the two symphonies varies quite a bit. For instance there is a good deal of surface noise in No. 101 that is quite absent in No. 94. And in 101 there is sudden damping at the end of phrases.

Here again you have the typical Toscanini drive which is never allowed to impair clarity of phrasing or articulation—if one excepts some string playing not quite out of the top drawer. But there is one thing I must mention which, had I done so as recently as 30 years ago, would have put me critically beyond the pale. That is the ridiculously fast tempo of the Menuetto in No. 94, though admittedly it is marked allegro molto. Tradition takes it much slower and in my opinion rightly so. But elsewhere Toscanini's affection for fast tempos is exhilarating. Try the first movement of the No. 94 and note its wonderful lilt delivered without any hint of scurrying. Tempos in No. 101 are more conventional. Toscanini certainly had a way with Haydn which it would do well to keep in mind when acquiring an issue like this.

★ ★ ★

BEETHOVEN—Symphony No. 6 in F (The Pastoral). The Creatures of Prometheus Overture. NBC Orchestra of New York conducted by Arturo Toscanini. RCA Victrola Stereo VICS1657.

There was a time back in the 1920s, 30s and 40s when Toscanini's Beethoven Symphonies were compared favourably with the revered Weingartner issue of some years before. With RCA's reissue of Toscanini conducting the Pastoral we have a chance of listening with a fresh ear, so to speak, and comparing this production with others that have followed more recently. Leaving the quality of the sound (1952) aside, the playing of the NBC Orchestra though splendidly unanimous—under Toscanini they dared not be anything but—is often individually less than beguiling. This, however, is very probably the responsibility of engineering.

Toscanini's first movement is a combination of drive and sensibility. His strict—and often fast—tempos make the movement move irresistably forward. His control of dynamics, considering the recording period, is superb. The climaxes swell slowly almost to bursting point. The reading is perhaps a little too stern for Beethoven in an unusually genial mood and among the other fine conductors of Toscanini's generation I prefer the rather more schmaltzy treatment of Bruno Walter.

Toscanini gets a wonderfully smooth flow to the music of the second movement. The fast tempo shouldn't worry many buyers because Toscanini preserves a truly rustic atmosphere. But what might disturb some is the relentless forward progress that allows for so few surprises. Just a little more elasticity would have made the music smile more benignly.

But this strict tempo becomes a virtue in the bucolic fun-making of the scherzo. Here the music smiles even if the conductor doesn't. But it is in the climax of this movement—the storm—that the recording technique of the time displays so many of its now corrected faults.

The Thanksgiving Finale starts with rewarding lyricism and moves into the heart-lifting realms of pure joy. This recording is a good sample for those who would bring a legend to life. And no doubt some of you will wonder what all the clamour was about.

The Creatures of Prometheus Overture provides a useful fill played with suitable contrasts between daintiness and drama by an unquestionable master of the musical theatre.

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Devotional Records

SOUNDS OF PEACE FROM THE MESSENGERS. Stereo, Light LS-5634-LP. (From Sacred Productions Aust, 181 Clarence St, Sydney, and other capitals.) Also available on cassette.

According to the jacket notes, the Messengers is a group formed from young people mainly from one Memphis church, who are managing to combine a busy program of concert appearances with special university studies. The emphasis of their message is on peace, as evidenced by the track titles: We've Got A Hold On Peace—May I Introduce You To A Friend—Let Me Be An Instrument Of Your Peace—Would You—Now We Can Start To Have Peace—Fly Little White Dove, Fly—This Train's Bound For Glory—When The Saints—Where's Christmas?—Spiritual Favourites Medley—Turn Our Hearts.

My initial reaction to the group was lukewarm, partly because the Messengers seemed like just another youth group, and partly because diction, necessary to get their message across, seemed to be secondary to harmony. But the impact grows, as track follows track, and it becomes evident that they are a very professional group, polished by a continuing schedule of stage and television appearances. The sound is good and, provided you don't have an aversion to the modern driving beat, you'll enjoy it. (W.N.W.)

★ ★ ★

THOMAS EDMONDS Sings Songs Of Faith, Volume 3. Stereo, RCA Camden VCL1-0050.

If you like hymns and sacred songs sung in the traditional manner, you are certain to enjoy every moment of this recording. Thomas Edmonds, who nowadays seems to share his time between Australia and Britain has a fine tenor voice, powerful and true, and excellent diction. Competently backed by organist Barry Hall, Thomas Edmonds sings some numbers as solos, others with the support of the Pembroke School Girls' Choir.

The track titles: Blessed Assurance — Star Of God — Sweet Bye And Bye — If With All Your Hearts — To God Be The Glory — O Come, O Come Emmanuel — In The Garden — Consecration — Panis Angelicus — God Be With You.

Recorded in Adelaide, in the Mastersound Studio, with Max Pepper at the console and producer Ruth Edmonds, the quality and balance is excellent and the pressing is absolutely clean. As I indicated at the outset, if you like traditional hymns in the traditional manner, this will be a special bargain, particularly at the Camden price. (W.N.W.)

THE 2ND CHAPTER OF ACTS. Stereo, Myrrh MST-6526-LP (From Sacred Productions Aust, 181 Clarence St, Sydney, and other capitals. Also available on cassette).

The jacket carries the words of Acts chapter 2, from Today's English Version. Tucked inside the jackets is a sheet carrying the words of eleven devotional songs centred on the life of Christ and the Christian way of life: Which Way The Wind Blows—Goin' Home—With Jesus—The Devil's Lost Again—Love, Peace, Joy—I Don't Wanna Go Home—Easter Song—He Loves Me—Good News—I Fall In Love—The Son Comes Over The Hill.

The vocal group comprises Anne Herring, Buck Herring, Nelly Ward and Edward Overstreet, with backing from bass, drums, guitar, piano, organ and synthesiser. A talented group, their sound ranges from hard rock to a gentle harmony on the final track.

Who will it interest? Those who have an ear for evangelical rock gospel, I would judge mainly from the rising generation. Definitely not for the wrinklies! (W.N.W.)

Instrumental, Vocal and Humour........................

RUDY VALLEE. HEIGH HO, EVERY BODY. GGS 1454 Mono Astor Gold Series.

This is really digging in the past, back to the roaring twenties and thirties in fact to Rudy Vallee's hey-day.

Whoever did the remastering on these tracks did an excellent job; the only apparent thing missing is a lot of highs. The tracks are: Vieni, Vieni — Sweet Music — Rain — Honey — Deep Night — As Time Goes By — S'posin' — If I Had A Girl Like You — I Love You Sweetheart Of All My Dreams — Life Is Just A Bowl Of Cherries.

Listening to these recordings of the 'original crooner' you can understand the reasons for their long-term popularity. Summing up: a record for the 'oldies' to sit back and enjoy. (N.J.M.)

★ ★ ★

A TAPESTRY OF DREAMS. Charles Aznavour. Stereo, Festival L-35272.

Recorded originally on the Barclay label, presumably in Paris, this album by Charles Aznavour is nevertheless sung entirely in English — complete with an accent that is so characteristically and intriguingly French. Following the age-old theme of l'amour he sings: She — From Today — Our Love, My Love — La Barraka — You've Got To Learn — We Can Never Know — The "I Love You" Song — I Live For You — After Loving You — Yesterday When I Was Young.

I can't say that I'm enamoured with the Aznavour voice but his popularity as an artist cannot be denied. And what he does here, he does well. The backing is good, as also the general sound. It's over to you. (W.N.W.)

★ ★ ★

MUSIC TO WATCH GIRLS BY. Vol. 2. The Paul Robinson Players. Stereo, Good Earth Records, W&G, WG.25/S/5610.

I cannot recall having previously encountered the Good Earth label, being manufactured and distributed in Australia by the Melbourne based company W&G. But this album, which is apparently one of a series of six by Paul Robinson, would slot right into the programming of Sydney's "good music" station 2CH, or its counterparts in other capitals. Lest there be any misunderstanding "good music" in this context means gentle; easy on the ear; music to relax by. Music with a strong but rounded rhythm bass and emphasis on the melody line.

The titles, suitably "girlie": My Cherie Amour — Chim, Chim, Cheree — Music To Watch Girls By — Charade — This Is My Song — Raindrops Keep Falling On My Head — Theme From Moulin Rouge — Man And A Woman — This Guy's In Love With You — Up, Up And Away.

The quality is okay, the playing is good and if you fancy two sides of easy listening — whether or not you watch girls — this one will make you well content with your purchase. (W.N.W.)

Reviews in this section are by Neville Williams (W.N.W.), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), and Norman Marks (N.J.M.).

YELLOW RIVER CONCERTO. Ilana Vered, piano; National Philharmonic Orchestra; conductor Edgar Howarth. Also Piano Concerto No. 21 in C K.467 (Mozart). Ilana Vered; Royal Philharmonic Orchestra; conductor Lawrence Foster. Stereo, Decca Phase 4, PFS4299.

No composer is named for the Yellow River Concerto, a work from modern China, but the sleeve note reveals that it was "communally adapted into its present form by the Central Philharmonic Society" from "Yellow River Cantata" composed by Western-trained Hsien Hsing-hai. The music is strongly melodic in style, reminiscent of the modern cinema "concerto"—in fact, if Richard Addinsell had composed a "Peking Concerto" for a film about China, this is how I would expect it to sound. A trifle "corny" perhaps, but it is pleasant enough corn with some good melodies. The playing of the solo part by Ilana Vered is impressive—technically assured and with a fine tone.

Miss Vered uses these qualities to excellent effect in a very enjoyable account of the Mozart concerto on side 2—although here perhaps a rather more incisive approach might have been used. (H.A.T.)

★ ★ ★

THE STAPLETON COLLECTION. Cyril Stapleton and his Orchestra. Quadraphonic, Astor 4D series, QUAD-1024.

You like to be surrounded by gentle music, very easy on the ear? Music you can turn down low or up high, according to the mood of the moment? Well, the Cyril Stapleton Collection will be just what the doctor ordered!

There are fourteen numbers altogether in a generous program: Sleepy Serenade — Themes from "The Sting" — Free As The Wind — Eye Level — Love Makes The World Go Round — Shine Softly In The Moonlight — Albatross — Welcome Home — And I Love Her — Spanish Eyes — Amazing Grace — Corner Of The Sky — I Don't Know How To Love Him.

The sound is absolutely clean and the quadraphonic facility keeps the percussion and much of the featured sound up front, while filling the room with the gentle sound of strings. In its class, a beauty! (W.N.W.)

★ ★ ★

OUR GOLDEN FAVOURITES, THE MILLS BROTHERS. MCA COPS 1019. Stereo. Astor release.

This record makes me all nostalgic for some of the "good old days" BT (before television) when radio was king and everyone listened to the hit parade. In those days one was always sure to hear one of the Mills Brothers' offerings among the top and, if you listen to this record with their easy harmonising, you'll understand why.

Reader's Digest special—"Today's Million Sellers"

TODAY'S MILLION SELLERS. Various orchestras, artists. Reader's Digest 9-record boxed set.

According to the legend on the box, the 18 sides on this 9-record set contain "108 great songs". Whether the "million sellers" description is a euphemism or a statistical fact I'm not sure, but there are certainly plenty of very popular tunes among them.

Record 1 exploits the "Happy Million Sellers" theme and leads off with Lynn Anderson and "Snowbird". Johnny Matthis, Andy Williams, Ray Conniff, Percy Faith, Jerry Vale, Liza Minnelli and others add their talents.

Record 2 turns to the movies, with additional help from Robert Goulet, Carol Burnett, Tony Bennett and Bobby Vinton. "The Godfather" is there, "Raindrops", "Candy Man", "Jean", "Everybody's Talkin" and several others.

Tired of the big city? Well, record 3 sees to that with a round dozen "civilised" C & W songs, starting with "Behind Closed Doors" and rounding off with "Little Green Apples". Charlie Rich, Johnny Cash, Ray Price, Jimmy Dean and even Peter Nero add their names to the growing list of talent.

Then to England for their million sellers and here we meet Patti Page, Jim Nabors and Andre Kostelanetz and titles ranging from "Alone Again" to "Clair", "Let It Be", "Michelle" and "Amazing Grace".

Record 5 is titled "For The Good Times"; record 6 carries the "Big Million Sellers" like "Troubled Waters", "Aquarius", "My Way", "Light My Fire" and "I Am Woman"—the last named by the Ray Conniff Singers. Then we turn to romance for a dozen tracks, and on some of the newer millionaires: "2001 Theme", "Yellow Ribbon" and "I Love You So".

Having listened your way through those 96 tracks, the final theme title would seem almost self-evident: "I Believe In Music"!

Produced for Reader's Digest by CBS, the general balance and quality of the individual discs is consistently good, with excellent stereo separation—this based on as many of the 108 tracks as I could reasonably sample without staying up all night!

In short, it's an album of typical middle-of-the-road music, performed by well known and capable artists. It is strong on melodic appeal but is quite distinct from the "hotel elevator" style. It should have wide appeal.(W.N.W.)

For information on World Record Club albums, contact the Club at 605 Camberwell Rd., Hartwell, Vic. 3124. Tel. 29 3636.

With the backing of Sy Oliver's orchestra on some tracks, the titles are: Paper Doll — I'll Be Around — You Tell Me Your Dream, I'll Tell You Mine — Till Then — You Always Hurt The One You Love — Don't Be A Baby, Baby — Across The Alley From The Alamo — Be My Life's Companion — The Glow Worm — Queen Of The Senior Prom — Smack Dab In The Middle — Opus One. Considering the likely age of some of the masters, the quality is good. (N.J.M.)

★ ★ ★

THE INDISPENSABLE EARL HINES. 1929-1939 Volume 1. RCA Vintage mono LPV-1024

Some very enjoyable music is played on this disc. It shows the development of Earl Hines as a bandleader long before he developed his reputation as a piano soloist and virtuoso improviser. All of the players accompanying him are identified and they include names that were to become famous in their own right later on. Do not worry too much about quality — this disc will become a collector's item.

The list of tracks reads as follows: Sister Kate — Glad Rag Doll — Grand Piano Blues — Indiana — G.T. Stomp No 1 — G.T. Stomp No 2 — Ridin' and Jivin' — Grand Terrace Shuffle — Father Steps In — Piano Man — Riff Medley — XYZ — 'Gater Swing — After All I've Been To You. (L.D.S.)

VARIETY FARE

THE STAR OF MYKONOS. Katja Ebstein. Stereo, Festival L-35270.

Released originally on the United Artists Label, this album was originally recorded in Germany — in English! Katja Ebstein is a highly photogenic lass, with any amount of style as a popular singer, and a depth of feeling to match. The songs: The Poor Boy Dancer From Peru — Close To You — Make The World A Better Place — River Run, River Flow — He's Back Again — It's Amazing — The Star Of Mykonos — You'll Be Gone — Grown-Up Games — A House Is Not A Home — No More Love For Me — Without Love.

Stereo spread and balance is okay; quality is a trifle edgy, but not enough to upset you if you want to hear what Katja Ebstein has to say. (W.N.W.)

★ ★ ★

SWAN LAKE — Suite (Tchaikowsky). Philadelphia Orchestra conducted by Eugene Ormandy. Stereo, RCA Red Seal ARL1-0030.

Ormandy has arranged these excerpts from Tchaikowsky's greatest ballet in the order they appear in the original score, so that the opening number is not the great Swan Theme — this appears well into side 1. All the main tunes usually found in Suites are here, including the charming little Dance of the Little Swans — Four National Dances from the Ball Scene — Black Swan Pas de Deux — Waltz from Act 1 — and so on. The Philadelphia provides the high standard of performance one expects from such an eminent orchestra, and the RCA recording is up to standard. (H.A.T.)

★ ★ ★

THE BIG BAND SOUND OF LIONEL HAMPTON. Metro records 2356 140 Mono Phonogram release.

I'm glad to see a release based on old masters where the engineers have been good enough to leave out the usual "electronically reprocessed for stereo" gimmick and this record certainly does not lose for being left in old fashioned "steam" mono.

Recorded at various sessions from 1951 to 1955 it includes thirteen of Hampton's best known numbers: Oh Lady Be Good — Cool Train — Gaby's Gabbin — It's A Blue World — Love You Like Mad — Swingin' On C — Air Mail Special — Gates Steps Out — Kingfish — Midnight Sun — Gladysee Bounce — Samson's Boogie — Flying Home.

The excellent sleeve notes give full information on the soloists for each track and the record would be an ideal way to replace ageing 78's and early L.P.'s. (N.J.M.)

THE JACQUES LOUSSIER TRIO IN CONCERT AT THE ROYAL FESTIVAL HALL. Philips stereo 6370 550.

About two years ago, when the Jacques Loussier Trio were last in Sydney, I was able to see them at the Town Hall. I was disappointed really—they did not seem to come to life. Perhaps the venue was unsuitable. But on this disc everything seems to gel and they appear to be having a marvellous time.

What they do to Bach compositions has to be heard to be believed and even then it is not quite credible. And their sense of timing is breathtaking. Add to that their sense of humour and you get a brilliant result. You're not mistaken—this is a rave review.

I suppose I should mention on the side, that record quality is excellent. No complaints at all. If you like the idea of jazz improvisations on Bach then this disc is a must.

Tracks are as follows: Toccata in D Minor—Fugue No 5 in D Major—Esquisse—Jesu, Joy of Man's Desiring—Fantasie in C Minor—Prelude No 1 in C Major. (L.D.S.)

★ ★ ★

FIEDLER'S GREATEST TV HITS. Boston Pops Orchestra, conductor Arthur Fiedler. Stereo, RCA Red Seal ARL1-0274.

An extremely varied program here, ranging from a C & W selection (featuring the elegant guitar playing of Chet Atkins) to operetta (Overture to "Gypsy Baron"); a 16-minute selection from Shchedrin's Ballet adaptation of Bizet's "Carmen" to Wechter's "Spanish Flea". Other titles are: American Patrol—Play Me—Grand Galop Chromatique (Liszt)—Waltzing Cat (Leroy Anderson)—Everything is Beautiful. I find Fiedler's scoring of the lighter numbers a trifle heavy-handed, but his large following will find plenty to enjoy here. The recording is O.K. (H.A.T.)

★ ★ ★

MOOG AT THE MOVIES. Synthesonic Sounds. Stereo, Astor 4D series SPLP-1430.

Having passed through an initial phase as a source of novel sound, the synthesiser is finding a niche, as here, fronting a group of normal acoustic instruments. And with its endless variety of sonic effects, it can constantly add new interest to the group sound while, at the same time, serving the mood of the music.

The movie themes presented here include: Live and Let Die—Poor People—For A Few Dollars More—Clockwork Orange—Day By Day—Superfly—I Don't Know How To Love Him—Shaft—Everybody's Talking—The Godfather Theme—Also Sprach Zarathustra—Duelin' Moog—Cabaret—Help—Let It Be & Mrs Robinson.

Also Sprach Zarathustra (theme of 2001 Space Odyssey) doesn't fare too well in this scaled down form but the rest of the music makes pleasant listening and is a good example of the marriage of electronic and acoustic sound. The quality is very clean. (W.N.W.)

★ ★ ★

THE GREAT GATSBY ERA. The Victor Silvester Orchestra. Astor SPLP 1438 Stereo.

The Strict Tempo fans get their money's worth in this fourteen track medley of hits from the Twenties played by the two Victor Silvesters, father and son. My only complaint is the use of the old "sock over the microphone trick" as there is virtually no highs to speak of! Apart from this the record is pleasant to listen to.

The tracks are' Miss Annabelle Lee—Chili Bon Bon—Remember—My Wonderful One—Yes Sir That's My Baby—Don't Bring Lulu—Poor Butterfly—Doing The Racoon—If You Knew Susie—Always—Because I Love You—Whispering—She's Funny That Way—Someone To Watch Over Me. (N.J.M.)

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VARIETY FARE

MUSICAL MOMENTS WITH MANTOVANI. Decca stereo SKLA 5187.

Mantovani and his orchestra put out a real musical pot-pourri on this disc. The arrangements are perhaps a little more saccharine than usual for Mantovani but that will not deter his fans. Surprisingly though, for a disc from this source, record quality was not good, suffering from the edginess typical of inner-groove distortion but prevalent in most tracks.

Tracks are as follows: And I Love You So—Eye-Level—La Chanson De Maria—For All We Know—Tie A Yellow Ribbon Round The Ole Oak Tree—It's Different Now—Say, Has Anybody Seen My Sweet Gipsy Rose?—Our Last Affair—Elizabethan Serenade—Fool—Dear Father. (L.D.S.)

★ ★ ★

HIT THE ROAD TO THEMELAND. The Tony Hatch Orchestra. Quadraphonic, Astor QUAD-1025.

If you're a confirmed TV watcher, you may warm to the sixteen TV themes presented here by Tony Hatch — or to at least as many of them as are screened in this country. Being a relatively spasmodic viewer, I tended to react to the album more as orchestral bits and pieces, vaguely familiar at times, but otherwise just music!

Included are themes from such shows as The World At War, M.A.S.H., The Champions and The Odd Couple, to mention those I have seen or noted in the programs. Most of the others are from BBC, ATV or British local TV, not seen in this country.

If the contents do interest you, you'll find the quality okay, without being startling; the same remark would apply to the 4-channel spread. (W.N.W.)

★ ★ ★

PETERS & LEE. RAINBOW. Philips 6308 208. Phonogram release.

The jacket photo of this record shows them as a pleasant looking young couple — Lennie Peters and Diana Lee. I understand that Lennie Peters is blind but, despite the handicap, they do a good job with this collection of fourteen ballads. Orchestral direction is by Peter Knight and the titles are: Rainbow — Vincent — The Jet Set — Seasons In The Sun — When Somebody Thinks You're Wonderful — Everloving Arms — So Little Time — The Sound Of Peace — Don't Stay Away Too Long — So Sad — All I Want To Do — But I Do — You Belong To Me — Send In The Clowns.

The quality is good. I think we will hear more of this couple, if they keep up this standard. (N.J.M.)

BOOTS RANDOLPH'S GREATEST HITS. Monument Records L35246. Festival release.

Anyone with a liking for virtuoso sax playing should give this collection of Boots Randolph's best sellers a good hearing. The quality is excellent on the twelve titles: Yakety Sax — Smoke Gets In Your Eyes — Gentle On My Mind — Stardust — Big Daddy — Hey Jude — Charlie Brown — Proud Mary — Danny Boy — Wabash Cannonball — You've Lost That Lovin' Feeling — Shadow Of Your Smile. As you can see from the list there is a good mixture of favourites old and new, to please everybody. (N.J.M.)

★ ★ ★

BILLY BURTON BEAUTIFUL BRASS. Stereo, Festival L-25148.

Happy music, pleasant music, are the terms that come to mind when one listens to this $3.99 Billy Burton album. To be sure, the sound has a lot more "bite" than would the same numbers from massed strings but, if you're partial to melody trumpet, then you should enjoy this program of popular numbers: Days Of Wine And Roses—Volare—Surrey With The Fringe On Top—Our Love—The Last Time I Saw Paris—People—Alice Blue Gown—Cherry Pink And Apple Blossom White—Call Me—Oh You Beautiful Doll—Call Me Irresponsible.

Balance, quality and surface are okay. (W.N.W.)

Books & Literature

Modulation theory

DELTA MODULATION SYSTEMS, by R. Steele. Published by Pentech Press, London, 1975. Hard covers, 222 x 143mm, 382pp, many line diagrams. Price in UK £10.00.

A fairly specialised text, written primarily for practising engineers, senior college students and research workers. The author is a senior lecturer in electronics at Loughborough University of Technology.

It is virtually a monograph on the specialised "delta modulation" digital encoding technique. After introducing the basic concept of the technique descriptively, it deals progressively with the mathematical analysis of both the technique itself and its primary applications.

Included is a comparison between conventional pulse code modulation and delta modulation, and an analysis of the performance of multi-level delta modulation. Finally a description is given of the application of delta modulation techniques to digital filtering and instrumentation.

The text is written in concise prose, and appears to be adequately served by illustrations. In short, then, a valuable reference work.

The review copy came from the UK publisher, who gives no details of local price and availability. (J.R.)

Amateur radio

SPECIALISED COMMUNICATIONS TECHNIQUES for the Radio Amateur, published by the American radio Relay League, Inc., Newington, Connecticutt, 1975. Soft covers, 165 x 241mm, 208pp., many illustrations. price in Australia $4.75.

Another of the "specialised" ARRL publications for the radio amateur, this time dealing with more esoteric techniques such as amateur television, facsimile, radioteletype and space communications.

As with most of the other ARRL publications, it is largely a distillation of the "meat" contained in articles previously published in the League's magazine "QST". And as usual, this has been done very well, to produce a concise and very valuable reference manual.

There are seven chapters, the first of which is merely a short introduction to the concept of "specialised communications techniques" as an important facet of amateur radio activity. The second and third chapters then begin the book proper, dealing respectively with fast and slow scan amateur television. Then chapter 4 deals with facsimile, chapter five with radioteletype, and chapter 6 with space communication — dealing with both satellite work and earth-moon-earth (EME) contacts. Finally chapter 7 looks briefly at techniques less developed at present, such as laser communications, digital and pulse communications, etc.

The text is well written, and smoothly integrated despite its varied origins. This together with its highly practical orientation should make it of great value to anyone seeking a reference on the techniques covered.

Review copies came from Dick Smith Electronics and Technical Book and Magazine Company, both of which advise that the book is in stock at their stores. (J.R.)

. . . and another

TEST EQUIPMENT FOR THE RADIO AMATEUR, by H. L. Gibson. Published by the Radio Society of Great Britain, London, 1974. Hard covers, 190 x 255mm, approx 110pp many photographs and diagrams. Price in Australia $6.65 plus postage.

A second collection of material published in amateur radio magazines, this time from the RSGB and "Radio Communication", and concerned with test and measuring instruments. While fairly basic and generalised, it naturally directs most attention to those instruments and techniques of direct interest to the radio amateur.

There are 11 chapters in all, whose headings give a fairly good idea of the material covered: 1 — Indicating Instruments; 2 — Electronic Instruments; 3 — The Dip Oscillator; 4 — Frequency Measurement; 5 — RF Power Measurement; 6 — Noise Measurement; 7 — Aerial and Transmission Line Measurements; 8 — Components, Valves and Semiconductors; 9 — Signal Sources and Attenuators; 10 — Oscillators and Swept Frequency Measurements; 11 — Reference Data.

Broadly speaking, most of the circuits and information given will be fairly familiar if you are a regular reader of Radio

THE SEMICON-DUCTOR INDEX

SEMICON INTERNATIONAL TRANSISTOR DATA MANUAL 1975 (5th) EDITION. Published by Semicon Indexes Ltd.

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Books—continued

Communication, and also if you have a fairly recent copy of the RSGB manual. There does not appear to be much new material, and some of the circuits are now beginning to look a little dated. However if you don't have a copy of the manual, and are not a regular reader of their magazine, it would make a useful reference. Certainly it is not expensive, and there is a good deal of general reference data.

The review copy came from the Technical Book and Magazine Company, of 289-299 Swanston Street, Melbourne, who advise that they have ample stocks. Post and packing within Victoria is 60c, or 80c to other states. (J.R.)

New Products

10MHz Oscilloscopes from Trio

There can be no doubt that the price/performance ratio of solid-state oscilloscopes improves as time goes on. As evidence of the trend, we review here two 10MHz oscilloscopes from Trio, the single-trace CS-1557 and the dual-trace CS-1554.

Discussing the single trace unit first, the CS-1557 is an all solid-state CRO with a 130mm diameter CRT. It provides DC to 10MHz (minus 3dB point) bandwidth and sweep rates of 0.5uS/cm to 0.5sec/cm. It is housed in a case of modern appearance and has dimensions 225 x 175 x 400mm (W x H x D). Weight is 6.4kg.

Vertical deflection sensitivity is variable in eleven ranges from 10mV/cm to 20V/cm, with continuous variation available on each range by means of a small knob concentric with the range switch.

The CS-1554 has the same 10 x 8cm display area, albeit with a circular instead of rectangular mask. Specifications for vertical sensitivity and timebase speeds are identical with the single trace model.

Five display modes are available at the flick of a switch: Ch1, Ch2, Chopped Sweep, and Alternate Sweep and Add. The "Add" mode allows the two signals to Ch1 and Ch2 to be combined in a single trace display. A "Subtract" mode is also possible by inverting Ch2 in the Add mode. This is achieved by pressing the push-button concentric with the Mode switch.

Ch1 and then from Ch2 and so on. The effect of this is to render both traces stationary, irrespective of whether they are phase and harmonically related or not. In some cases the traces may have a little horizontal jitter, but this can generally be minimised by adjustment of the Trigger level and Stability controls. This is an ingenious idea and the Trio CS-1554 is the first we have seen with it.

Removing the covers of both the oscilloscopes reveals a spacious, easily accessible interior with all circuitry mounted on two large boards. Good quality components are used throughout.

Time did not permit us to closely check the oscilloscopes' performances so we had to content ourselves with quickly putting them through their paces. We can state that their sensitivity and bandwidth are within the specifications. Timebase linearity was very good as was trace focus.

We did notice that the traces on both oscilloscopes were not quite horizontal. This is easily adjusted on the single trace model CS-1557 by loosening three screws at the rear and rotating the CRT socket cover.

Another problem we noted on both units was the tendency for a bright vertical line to appear at the start of the trace when the intensity was turned up. This would indicate that the retrace blanking circuitry is not quite optimum. However this would not be a problem in normal use.

Nineteen ranges are provided for the timebase with continuous adjustment again provided by a small knob concentric the range switch. As well, the horizontal trace position control can be pulled out to provide 5X magnification of the displayed signal.

Three slide switches provide a fairly comprehensive sync and triggering facilities, in conjunction with a knob which varies the trigger level. Sync can be switched to Normal, TVL (uses TV line sync pulses) or TVH (uses TV frame pulses). Screwdriver preset controls are provided for DC balance and trigger stability.

An interesting feature is the sync source selector slide switch. Selecting Ch1 enables the timebase to be synchronised to Ch1 signals and thus provide a stationary trace for that channel. The other trace may or may not be stationary, depending on its phase and frequency relationship to Ch1 signals. This is the case with any dual-trace oscilloscope.

When the sync source switch is moved to the Internal setting and the Mode switch is at the Alternate trace setting, the timebase is triggered alternately from

A well-written manual is supplied with each oscilloscope plus fuses and connecting leads. A 10X (attenuation) probe is supplied with the single-trace CS-1557 while two such probes are included with the dual-trace CS-1554. Since these probes are included at no extra cost, the all-up price of the CROs is quite attractive.

Prices are $295 plus tax for the CS-1557 and $359 plus tax for the CS-1554. Further information can be obtained from the Australian distributors for Trio instruments, Parameters Pty Ltd, 68 Alexander Street, Crows Nest, NSW 2065 or from major electronic parts retailers. (L.D.S.)

4½ Digit Multimeter from Data Precision

The newest instrument in the Data Precision line is the Model 1450. This is a 4½ digit multimeter for measuring AC and DC voltages and currents and resistance with 0.005% resolution. There are 21 ranges and 100% overrange capability.

Digital test instruments continue to become cheaper while their precision improves. The Model 1450 is 4½ digit unit with 100% overrange capability, ie, it will read to 1.9999. Polarity indication is automatic.

Sperry planar gas discharge readouts are used to provide highly visible, bright digits 12mm high. Overload indication on any range is indicated by the digits being extinguished to leave only the decimal point and plus or minus polarity indication alight.

In all, 21 measurement ranges are provided: 4 DC voltage ranges to 1kV; 4 AC voltage ranges to 500V; 4 DC current ranges to 1 amp, with overrange to 1.9999 amp; 4 AC current ranges to 1 amp, with overrange to 1.9999 amp and 5 resistance ranges to 10 megohms with overrange to 19.999 megohms.

Maximum input on any DC voltage range is plus or minus 1kV; on any AC voltage range 500V RMS. A 2 amp fuse in series with the input provides protection on the current ranges. These limitations mean there is no overrange capability on the 1kV DC range or the top AC range. In fact, the top AC voltage range is limited to 500V FSD, and not 1kV as the range switches might suggest.

Data Precision's multimeter uses planar gas discharge readouts.

Resolution is quoted at .005% for the voltage ranges while accuracy varies according to the range selected. On DC voltage ranges, accuracy is quoted at plus or minus .02% of reading plus or minus .01% of range full scale. On AC voltage ranges, accuracy is .08% of reading (from 50Hz to 1kHz) with reduced accuracy outside these frequency limits.

Space does not permit us to quote the very comprehensive specifications of accuracy which takes into account the voltage coefficient over time and the temperature coefficient. Operating temperature range is from zero to 40 Celsius.

Common mode rejection ratio is 120dB for DC and better than 100dB for 50Hz. Normal mode rejection is 50dB at 50 or 60Hz. Settling time (to settle within plus or minus 0.1% of final reading for a full-scale step input) is 2.5 seconds.

Conversion technique is Data Precision's patented "Tri-phasic" method which appears to be a development of the dual-slope integration technique.

A silk-screened panel on the rear of the meter gives details of calibration voltages for all ranges and all calibration adjustments are accessible without opening the case.

Case size is 216 x 95 x 215 (W x H x D) not including the handle which can be used as a tilting stand. Weight is 1.7kg. The unit is mains powered.

A set of test leads plus a well-written instruction manual is included with the unit. The manual even provides a flow diagram for troubleshooting faults.

It must be admitted that the model 1450 is a potent measuring package, especially when its low price is taken into account. Price is just $235 plus 15% sales tax where applicable.

Further information on Data Precision instruments may be obtained from the Australian Distributors, Kennedy Electronics, 142 Highbury Road, Burwood, Victoria, 3125 or their interstate representatives.

Meters from Paris Radio

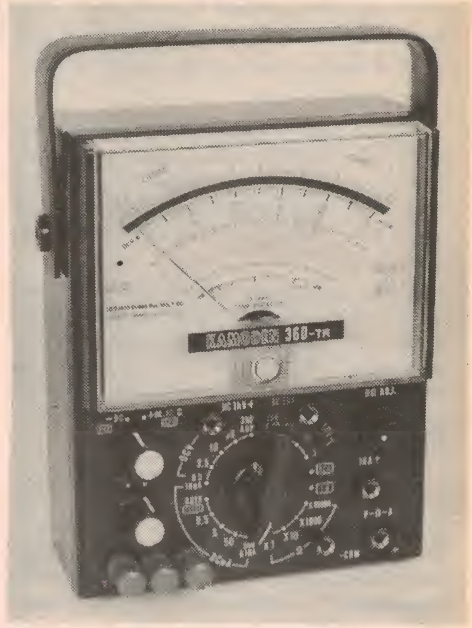
Paris Radio have available a comprehensive range of flush-mounting panel meters for use in a variety of applications. Nominal sensitivity is 500 microamps FSD.

Both single and dual meters are available in either edge-lit or back-lit types. While those illustrated have level or VU meter scales, there are quite a variety of scales for indicating stereo balance, signal strength and so on.

Trade enquiries should be directed to Paris radio, 7 Burton Street, Darlinghurst, NSW, 2010.

NEW PRODUCTS

Multimeter also tests transistors



Dick Smith Electronics is currently offering this high quality Kamoden 360-TR multimeter, which offers basic bipolar transistor and diode testing in addition to the normal multimeter ranges.

Physically and electrically the meter is very similar to a number of other 100,000 ohms per volt multimeters tested recently. It features a large 125 x 97mm meter movement, with its largest scale about 100mm long. A mirror backing strip is provided to allow parallax-free readings.

Some 34 ranges are provided, if one counts decibel readings made using the AC voltage ranges. DC voltage ranges are 0.5V, 2.5V, 10V, 50V, 250V and 1000V; AC voltage ranges 5V, 10V, 50V, 250V and 1000V; direct current 10uA, 25uA, 500uA, 5mA, 50mA, 500mA and 10A; AC, 10A only; ohms, R x 1, R x 10, R x 1000, R x 10k. The two transistor ranges are Icbo 0-50uA, and hFE 0-500. DC voltage measurement sensitivity is 100k/V, AC 10k/V, while the direct current voltage sensivity is 250mV. The centre-scale ohms reading is 20 ohms and its multiples. The basic meter movement is of 8.5uA sensitivity, and is provided with bipolarity diode protection—which is bypassed to prevent spurious readings.

Under test, the sample unit performed well, giving readings well within the quoted tolerances. The transistor testing facilities are fairly basic, but with a little intelligence could be used for general testing and selection of bipolar transistors.

In short, quite good value at the price of $45.00. Enquiries to Dick Smith Electronics 160-162 Pacific Hwy, Gore Hill NSW 2065 or their various branches.

Letters to the editor

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

S/N testing

We wish to thank you and your staff, particularly Leo Simpson for the review of the (S.A.E.) Mark 1XB Preamplifier–Equaliser. However I was astounded by your poor test result of signal to noise ratio.

In respect to signal to noise ratio, a resultant figure is obtained, as we all know, by measurement of the residual noise (hiss etc) with respect to signal output. In your review, no reference was made to the relative input or output signals. S.A.E. quote a guaranteed minimum Signal to Noise Ratio of 75db below 10mV Phono, and 90dB below High Level.

In your review you quote a measured Signal to Noise Ratio of 54db Magnetic Cartridge Input and 78db for High Level inputs (no reference). You also made mention, and I quote: "Checking out the ratings of the S.A.E. MK 1XB equaliser-preamplifier and 111CM power amplifier is almost a futile exercise since every specification was either met or exceeded." You then went on to say, following the Test Results: "In use, the combination is very pleasant and easy to use and is very quiet at even very loud settings of the controls".

In light of this discrepancy, we would greatly appreciate a clarification of these details published in a near future edition of your excellent magazine.

I. G. Bultitude, NSW Manager,
Leroya Industries Pty Ltd.

COMMENT: Unless otherwise specified by the equipment manufacturer, we have been measuring signal-to-noise ratios with respect to the maximum sensitivity of the amplifier or preamplifier, in this case, and with the input short circuit. We agree that referring the input noise to 10mV (and perhaps using a weighted measurement) gives a more realistic result and enables comparisons to be more easily made with other equipment.

In fact, in the light of your letter, we made a mistake in stating that the Mark IXB met or exceeded every specification. If the residual noise for the magnetic cartridge was referred to 10mV, the signal-to-noise ratio would be 68dB, which is still short of the 75dB you quote. Even a weighted measurement would probably still fall short.

Perhaps a somewhat different measuring method is envisaged by the manufacturer of SAE equipment, which may explain the discrepancy. In the future, though, we shall refer the signal-to-noise ratio of magnetic cartridge inputs to a 10mV signal at 1kHz.

Doppler Radar

Since our release of information on our Doppler Radar Module CL8960, we have learned that the Post Office Radio Branch have allocated the frequency band 10.500 to 10.550 GHz for low power intruder detectors. Although we have in the past referred rather loosely to our series of Doppler Modules as CL8960, this particular code number in fact specifies the frequency 10.687 GHz which is the frequency allocated in the United Kingdom.

As a result we apologise for any inconvenience that may result but must ask that you advise your readers that the correct device for use within Australia is CL8963.

The CL8960 is not withdrawn and of course remains available to any customer who may wish to export units to the U.K.

It may be useful to point out from our recent discussions with the Radio Branch of the APO that where X-band transmitters are used in Australia for intruder detectors, the following conditions apply.

(1) They must not produce any emissions outside the allocated band even allowing for effects of temperature and supply voltage variation.

(2) They must operate in the CW mode with a power output as measurable into a load of less than 50mW.

(3) The area controlled by the device is limited to the owner's premises.

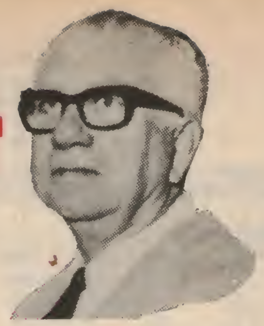
If these conditions are fulfilled then Doppler Alarms may be operated without a permit.

The CL8963 as delivered meets these requirements over the specified temperature range when used with recommended power supply circuits but it becomes even more important to emphasise that users should not tamper with the tuning screw on our units which is factory preset to ensure compliance with the regulations in force in the various countries for which they are intended.

P. Tracy,
Product Engineer, Elcoma,
Lane Cove, NSW.

The Amateur Bands

by Pierce Healy, VK2APQ



An epoch making event—50 years ago

During the past 50 years long distance radio communication has progressed from a limited, somewhat unreliable service to a complex system which includes radio teletype, speech and television. In the early stages, at least, much of the progress flowed from the experiments and tests carried out by amateurs.

Two populated islands on the earth's surface the greatest distance from each other are England and New Zealand, providing virtually the longest direct path in the world for a permanent radio communication link. It was, therefore, an epoch making date on the 18th October, 1924, when the first radio contact was made between the two islands.

On the occasion of the fiftieth anniversary of the first contact, a special celebration was held at Shag Valley, Waihemo, New Zealand. Guests of honour were Frank Bell, ZL4AA and his sister Brenda and the celebration was organised by the president of the Otago Branch of the New Zealand Association of Radio Transmitters Inc., Mr T. W. Rhodes, ZL4KG. It was attended by forty persons including 'old timers' and members of the Otago Branch.

The contact, which opened up the possibility of radio propagation on wavelengths below 100 metres, was between Frank Bell, then operating under the call sign Z4AA, and Cyril Goyder, G2SZ.

For the celebrations, two complete radio networks were set up in the lounge of the Bell's home and antennas erected in the grounds. Some 260 contacts were made, eight on 80 metres with English stations and innumerable world-wide on 40 and 20 metres. Frank and Brenda joined in these contacts, which included a 20 minute contact with the second station in England that Frank worked back in 1924.

Special commemorative QSL cards have been prepared and are being dispatched by ZL4KG.

A message was also sent via the Radio Society of Great Britain to Cyril Goyder, G2SZ who now lives in America. His reply read: "To Frank and Brenda Bell. Thank you for your message and I would like to also thank all the amateurs who have combined to get it to me and my greetings back to you on this wonderful occasion—Goyder, formerly G2SZ." It was telephoned to the RSGB and then by radio to New Zealand.

During the celebrations, Mr Bill Deverill, senior Radio Inspector, presented Frank Bell with photostat copies of historic correspondence which had passed between the NZ Post Office and the Bells.

In 1964, a commemorative cairn was erected by the Otago Branch of the NZART at Shag Valley, Waihemo. The inscription which is surmounted by the diamond shaped NZART official emblem reads:— "To commemorate the first New Zealand radio contact 18/10/1924 from here by stations Z4AA-G2SZ".

A further point of interest is that the NZART will be fifty years old in 1976. This is the official amateur organisation in New Zealand, devoted entirely to fostering the interest of amateurs throughout that country. Plans are being made to publish special material from all sections of amateur radio in the association's journal, "Break-in", which at present is in its 48th year of publication.

(Acknowledgement to "Break-in" Jan/Feb 1975)

SAFARI UP NORTH

When a husband and wife, both amateur radio operators, decide to go on a safari, there are sure to be interesting contacts made and stories to relate. This was the case when Hebe Grouse, VK2AOK and husband Dick, VK2AZG travelled in their landrover to the northern-most point in Australia, Cape York Peninsular.

Here is a brief account of one of the happenings as recounted by Hebe following, what she described a wonderful trip to the "top" by a party of fifteen vehicles from the Sydney landrover's club.

"Crossing the beautiful fast flowing Jardine River, 16kM from the 'Top' was the biggest obstacle but this was accomplished without much trouble and in fact we gave the group on the frequency a 'running commentary' and they all declared the signal strength to be much stronger half way across.

"However the force of the water 1.2 metres deep did considerably loosen the insulating base of the aerial and the grim condition of the north bank—a quagmire of mud and logs, out of which the landrover had to winch itself, caused the antenna system to be in need of urgent repair.

"We camped three nights on the north bank of the Jardine River at the telegraph crossing and it was only a couple of days ago I found out that those noises in the evening which I accepted as queer sounding frogs was no doubt 'crocodile talk'. Also, I won't easily forget the baby taipan snake who shared a rock with me on the bank of the Archer River.

"The VK4 boys were able to keep us informed on the petrol situation which was a worry at times, although we were carrying over a dozen jerrycans full. On the way back we were fortunate in that drums of petrol flown in to the remote settlement of Coen for the local folk attending the races had not all been used and we were able to replenish our tanks."

The front cover photograph shows them preparing to negotiate one of the many crossings which first had to be reconstructed. Note the 20 metre whip antenna on the landrover mudguard. The transceiver occupied the centre front seat.

LOCAL AND OVERSEAS NEWS

432MHz REPEATERS & BEACONS: The Postmaster General's Department has advised the Wireless Institute of Australia that a limited number of unattended repeaters and beacons will be permitted in the 420MHz-450MHz amateur band in Australia. An extract from a letter read over VK3WI news broadcast stated:—

"Following your recent representation to this office I am pleased to advise that, subject to certain necessary restrictions, the department is now agreeable in principle for the operation of a limited number of amateur unattended repeaters and beacons in the 420MHz-450MHz band.

"As the Amateur Service is secondary to the radio location service and as a portion of the 420MHz-450MHz band may also be used for space telecommand and space research purposes, it is regretted that it is necessary to impose additional restrictions to the operation of your equipment in this band."

A set of conditions quite similar to those now in force for the 2 metre band was set out. Also a request was made that the WIA provide a proposed frequency plan for repeater and beacon transmitter, in order that the proposal could be considered in detail.

"In this regard, because of the requirement of the primary service, approval of unattended equipment can only be considered at present in relation to operation in the 430MHz-440MHz portion of the band."

GHz RECORDS: On Saturday, 12th April, 1975, a group of Sydney amateurs lead by Des Clift, VK2AHC considerably increased the distance they had previously set for two-way contacts on the 5GHz (C band) and 10GHz (X band) amateur bands.

The path distance was 113.75Km between a point just east of Terrey Hills, grid reference 424838 about 20Km north of the city, to Mount Gibraltar about 2Km south west of Mittagong, grid reference 343743. The height above sea level at Terrey Hills was 220 metres and 847 metres at Mount Gibraltar.

The operators at Terrey Hills were Dave Ralph, VK2SB/P and Norman Champion, VK2ZND/P with Des Clift, VK2AHC/P assisted by Graham Wilkins, VK2YCN/P, operating from Mount Gibraltar.

For 10GHz the equipment used at Terrey Hills was a two dish system as described by Des in "Electronics Australia", 1972, while at Mount Gibraltar it was a new all solid state unit using a Gunn diode/circulator single dish system, with that and the IF modulator system all running directly from the 12 volt car battery, the total current drain being under 300mA.

The signals on 10GHz were readability five and strength nine. The 5GHz equipment was that used for the previous 59Km contact (see "Electronics Australia", April, 1974). It uses medium size horn antennas and Klystrons. In this case, due to lower antenna gains, the signals were only readability four and strength six, not enough to fully limit the IF. However the two-way reports were passed and a short conversation held.

In the note received from Des, his comments on the tests were:— "It looks as though I shall have to use the 762 millimetre dishes I have for S band if we are able to get results on C band as good as X band. Incidentally, the dish and feed used on X band was the same one I used in the first ever 3cm QSO I had with G3LZ in England back in 1952; even though it is rather battered it is still performing.

"The liaison link used for the tests was a 1.5 watt two metre NBFM and a five element yagi at Mount Gibraltar and a 10 watt four element yagi at Terrey Hills. Link signals were 'out of this world' compared with local signals around Sydney with the same gear, which again proves that 'line of sight' really makes things easy."

TOWNSVILLE PACIFIC FESTIVAL, CONTEST 1975: The aim of the contest is to foster an interest in the Townsville Pacific Festival, and to increase interest and activity on all amateur bands by Australian and New Zealand amateurs.

It will be noted that a further effort is made in this contest to increase popularity of the CW mode of communication. Hence all CW contacts count for double score.

This is the second year that the Townsville Pacific Festival contest has been run. Last year, 1974, the winner was L. W. Bell, VK4LZ who scored the highest points and received the trophy.

This year the organisers have included New Zealand (ZL) and Papua-New Guinea (P29) to add more interest in the contest. However, the trophy will be presented to the highest scorer in Australia.

Time of Contest: 12 hours duration from 0200 hours GMT to 1400 hours 15th June, 1975.

Sections:
(a) Transmitting all bands phone only.
(b) Transmitting all bands CW only.
(c) Transmitting all bands—open.
(d) Receiving all bands—open.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

AMATEUR BANDS

Contacts: (a) CW to CW contacts count as double score.
(b) One contact per band per mode only.
(c) No cross band contacts.

are permitted), for this purpose, a contact above 50MHz within an entrant's own call area will score one point. With the exception of VK4 where the bonus rule applies for contact with VK4WIT or other Townsville stations.

Contacts on 160 metres; Same scoring as in table with additional 5 bonus points per contact.

CONTACT POINTS TABLE

	VK1	VK2	VK3	VK4	VK5	VK6	VK7	VK8	P29 VK9	VK0	ZL
VK0	6	6	6	6	6	6	6	6	6	—	3
VK1	—	1	1	2	3	6	2	4	5	6	3
VK2	1	—	2	1	2	6	3	4	5	6	3
VK3	1	2	—	3	2	4	1	6	5	6	3
VK4	2	1	3	—	4	6	5	2	1	6	3
VK5	3	2	2	4	—	1	5	1	6	6	3
VK6	6	6	4	6	1	—	4	1	2	6	3
VK7	2	3	1	5	5	4	—	6	5	6	3
VK8	4	4	6	2	6	1	6	—	2	6	3
P29 VK9	5	5	5	1	1	2	5	2	—	6	3
ZL	3	3	3	3	3	3	3	3	3	3	—

Awards: (a) A certificate will be awarded to the highest scorer in each section for each call area per band.
(b) The entrant with the highest score will be awarded a certificate.
(c) Trophy awarded to entrant with highest overall score within Australia. Trophy to be held until next contest.

Scoring: Bonus = For contact with VK4WIT—15 points to be added to score shown on table. N.B. VK4WIT and other Townsville stations are the only VK4 stations that other VK4 stations can contact. Scoring for VK4WIT and other Townsville stations will be the same as for other VK4's. However, VK4WIT and Townsville stations will receive no bonus points.

VHF & UHF—Same as for HF except that on bands above 50MHz (i.e. intrastate contacts are permitted), for this purpose, a contact above 50MHz within an entrant's own call area will score one point.

Townsville stations will identify by:—
Example—(phone) VK4WIT Townsville
(CW) VK4WIT/TVL

Send logs to: Townsville Pacific Festival Contest,
P.O. Box 964,
Townsville, Qld. 4810.

Closing date of entries: 15th July, 1975.

NOVICE LICENCE

The Postmaster-General, Senator Reg Bishop, has announced that arrangements have been made for the introduction of Novice Amateur Radio Station Licences.

Senator Bishop stated that the Novice Licence is being introduced to enable persons who have not passed the standard Amateur Examination to engage in radio as a hobby on a restricted basis and gain the knowledge and experience necessary to qualify for a normal licence. This move by the Government had the wholehearted support of the Wireless Institute of Australia.

To become eligible for such a licence, persons will be required to qualify for a Novice Amateur Operator's Certificate of proficiency. The Certificate will be issued to any person, regardless of age, who passes a comparatively simple examination in radio theory and regulations and a Morse code test at 5 words a minute.

Senator Bishop said that the fee for a Novice Amateur Station Licence had been set at half the normal rate and would be $6 a year. The fee for the examination will be $2.

Novice Amateur Station Licencees will be permitted to operate within the bands 3.525-3.575 Megahertz (MHZ) 21.125-21.200 MHZ and 26.960-27.230 MHZ. All transmitters must be crystal controlled. Powers of up to 10 watts for double sideband and 30 watts for single sidebands transmission will be authorised.

Permissible modes of operation are A1, A3, A3A, A3B, A3H, A3J, and F3 (+ – 3kHz).

The first examination for the new licence will be held on 24 June 1975. Application forms may be obtained from the Radio Branch in each state or the District Offices. Examination fee is $2.00.

Limited licencees may obtain a Novice Licence on passing a Morse code test at 5wpm. This will be a separate licence, carrying a separate call sign, and for which an additional $6.00 fee will be charged.

FCC PROPOSAL

The February 1975 issue of "QST", the official journal of the American Radio Relay League, features what they refer to as "a new look" in amateur licensing, based on the proposal prepared by the United States Federal Communication Commission. It was pointed out by the ARRL that, at that date, it was a proposal only and the earliest that regulations to implement them could be announced could be mid-July, 1975. But there is no foregone conclusion that it is to be adopted. It is stated, however, that the proposed changes if adopted will substantially alter the makeup and nature of amateur radio.

The proposal provides for two series of licenses.

Series (A) covers the HF bands and (B) the VHF bands. There are three grades in each series; in (A) they are Novice; General and Advanced. In (B) Communicator; Technician and Experimenter. The holder of either the Advanced or Experimenter grades would be able to progress to the highest grade of Extra class licence.

Space does not permit going into details for each grade, but briefly, in the HF series the Novice level would require a basic exam on HF and 5wpm Morse code test; the General, an intermediate exam on HF plus a 13wpm code test; the Advanced, an advanced exam on HF.

In the VHF series the Communicator would require a basic exam on VHF only; the Technician an intermediate exam on VHF plus a 5wpm Morse code test; the Experimenter, an advanced exam on VHF.

To gain the Extra class licence both the Advanced and Experimenter licence holder would be required to pass a 20wpm Morse code test.

Interesting points on the lower grades are: in both cases the input power to the transmitter final amplifying stage is 250 watts. For the Communicator class all amateur frequencies above 144MHz and the emission F3 mode. The Novice frequencies stated are 3700-3750KHz, 7100-7150KHz except when operating in Region 2 when 7050-7075KHz will be the segment, 21.1-21.2MHz and 28.1-28.2MHz. Emission A1 mode.

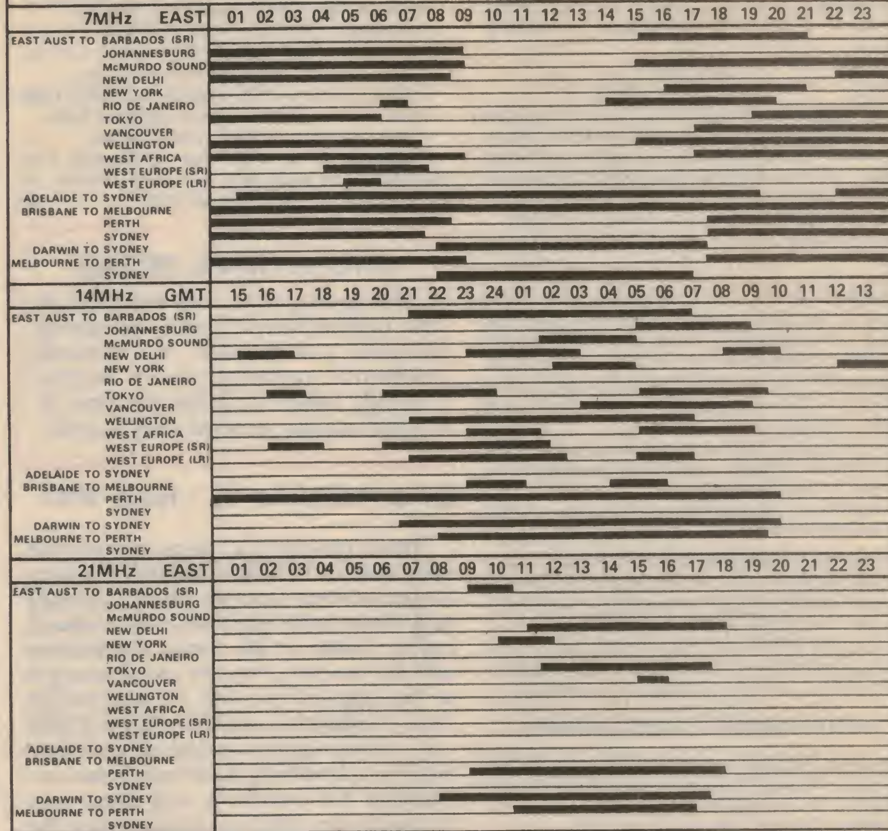
In the other VHF grades the maximum transmitter output is not to exceed 500 watts peak envelope power. The Experimenter class would be allowed all amateur radio operator privileges above 29MHz. The Technician class frequencies would be limited to those above 50MHz and emission modes of A1, A3 and F3.

In relation to power, the text of the FCC proposal reads: "In proposing maximum transmitter power levels, we have taken into consideration a number of factors. Amateur transmitters have not been a significant source of interference to other services, and where there has been a problem, amateurs have been very cooperative. Also amateurs, by and large, do use the minimum transmitter power necessary to conduct their communications.

"Therefore, there should be no real problem if the limits were to be increased in some instances. We would like to improve the technique specified in the Rules for determining power. Modern communication requires better methods for determining transmitter power than the 'plate voltage times current' method. We are proposing to specify the maximum transmitter output in terms of peak envelope power (PEP), except for the beginner level where emission authorised do permit a fairly accurate measurement to be made of the input power using the method now specified."

IONOSPHERIC PREDICTIONS FOR JUNE

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 6.75



RADIO CLUB NEWS

ACT DIVISION WIA: The following appointments have been made following the annual general meeting of the Australian Capital Territory Division, WIA:

President	Ted Pearce	VK1AOP
Vice-presidents	Rex Roseblade	VK1QJ
	Harry Vonthehoff	VK1KW
Treasurer	John Roberts	VK1ZAR
Secretary	Eric Piraner	VK1EP
Committeemen	Ed Penikis	VK1VP
	Phill Bowers	VK1YS
	Andrew Davis	VK1DA

The federal councillor is Ed Penikis, VK1VP.

During the first year as a division of the WIA, good progress has been made. A weekly news broadcast was inaugurated and has continued each Sunday evening at 8.00pm on 3595KHz, 27.125MHz and 146.5MHz. AOCP classes conducted, a 144MHz beacon placed in operation and a 2 metre FM repeater constructed, licensed and ready for installation.

Meetings are held on the fourth Monday of the month at the Studio, Griffin Centre, Postal address is PO Box 1173, Canberra City, 2601.

WA VHF Group: A VHF hidden transmitter hunt conducted by the Western Australian VHF group was somewhat unconventional as there was no signal audible until the hunters got within 45 metres of the hiding place. Those participating were "talked in" to a short distance from the site which was located on the ocean front at Triggs.

The group also proposed to hold an instructional class for repeater operators.

GOLD COAST RADIO CLUB: The repeater call sign of the CCRC repeater VK4WIG/R1 is to be changed to VK4RGC. A log sheet showing 100 contacts through the Gold Coast Repeater will gain a certificate for the "Repeater One Hundred Club". Providing the same station is only claimed once in any one week. The club is open to all amateurs and shortwave listeners.

Applications should be sent to the Awards Manager, Gold Coast Radio Club, PO Box 588, Southport, Qld. 4215. A stamped, self addressed envelope must accompany the application.

UNIVERSITY OF NSW AMATEUR RADIO SOCIETY: At the annual election of office bearers the following appointments were made:

President	Steve Blair	VK2BZB
Vice-president and treasurer	Frank Sobora	VK2BHQ
Secretary	John Hargreaves	VK2ZOH
YRCS liaison officer	John Lowe	VK2BZJ
Publicity officers	Sam Voron	VK2BVS
	Tom King	VK2ATI

A sincere vote of thanks was passed to Sam Voron, VK2BVS for his contribution to the society, being its founder and most enthusiastic member.

The club meets in room 601, Electrical Engineering Building, University of NSW, Kensington. Postal address: Union Box 57, PO Box 1, Kensington, NSW, 2033.

MOORABBIN & DISTRICT RADIO CLUB: At the conclusion of the March general meeting of the MDARC 102 members and visitors saw a demonstration of black and white and colour amateur television. This demonstration was organised by Peter Cossins, VK3BFG of the Melbourne ATV group and commenced with a video-taped talk by Peter on ATV transmitter block diagrams, modulation methods, power outputs and typical home built equipment.

This was followed by two colour films on integrated circuits broadcast from Lou De Stefano, VK3ZYD location at Mt Dandenong using Don Bradbury, VK3YV transmitter and Les, VK3BEN, video recorder. Another film was also transmitted by Les Jenkins, VK3ZBJ at Frankston.

Meetings of the MDARC are held on the first and third Friday evenings of each month at the Moorabbin Baseball Club Rooms, Summit Avenue, Moorabbin at 8.00 p.m.

WESTLAKES RADIO CLUB: The chairman for the election of officers of the WRC for 1975 was Geoff Moore, well known for his ABC Radio 2NC program "Moore for Breakfast". The senior officers elected were:

Director:	Keith Howard	VK2AKX

AMATEUR BANDS

Senior co-director	Joe Waugh	VK2IQ
Co-director	Stan Lloyd	VK2AYL
Secretary	Eric Brockbank	VK2ZOP
Minute Secretary	Daryl Boyce	
Treasurer	Max Maclachlan	

YRCS classes are conducted at the clubrooms York Street, Teralba each Saturday afternoon from 1.30pm. The AOCP classes being held on Monday and Wednesday evenings. Class lectures are given by Keith Howard, Colin Colgan and Jamie Campbell. Morse code instructors are Joe Waugh and Wal Lean.

Postal address of WRC is PO Box 1 Teralba, NSW 2284.

MAITLAND RADIO CLUB: More than 100 people attended the club's second major field day. The venue was the club headquarters, Maize Street, Tenambit. Those attending included amateurs and their families from surrounding districts and Sydney. Hidden transmitter hunts and novelty events were keenly contested.

During the day, films were screened in the club's theatrette and a display of electronic equipment was on view in the clubroom.

Following the success of the event it seems certain that another field day will be organised for 1976.

ST GEORGE AMATEUR RADIO SOCIETY: It has been stated that work is proceeding on the setting up of the SGARS repeater at Engadine. This installation will serve the southern areas of Sydney.

The society meets on the first Wednesday of each month, in the Rockdale Civil Defence HQ., Highgate Street, Bexley, at 7.30 p.m. Visitors are welcome.

YOUTH RADIO CLUB NEWS

The NSW state supervisor of the YRCS reports that as at 31st March, 1975 the following clubs had registered with the NSW division.

Crestwood Radio Club, Baulkham Hills.
St George YRCS Training Annexe, Brighton-le-Sands.
CAMTEC (formerly Camp Technology) Mt Victoria.
Westlakes Radio Club, Teralba.
Armidale Police Boys Radio Group, Armidale.
Whalan High School Radio Club, Whalan.
Swansea High School Radio Club, Swansea.
Normanhurst Radio & Electronics Club.
Katoomba High School Electronics Course.
Cessnock High School Electronics Course.
Kogarah Marist Brothers High School Radio Club.
Marsden High School Radio Club, West Ryde.
Penrith High School Radio Club, Penrith.

Full details of the YRCS may be obtained from the NSW state supervisor, Rex Black, VK2YA, 10 David Street East, Springwood, 2777.

SHORTWAVE SCENE

We apologise for the omission of our regular feature under the above heading. Unfortunately, the material from our correspondent, Arthur Cushen, failed to arrive on time. It should appear as usual next month.

D/C Receiver . . . from P41

The receiver performance is more than adequate for the job specified. The prototype suffered from an overly powerful neighbour, (all of 50 yards) who conducts nightly skeds on 80: audio rectification was the problem. In spite of the strength of the signal, there was no perceivable cross-modulation on other signals. Other very strong signals caused no problem. While no sensitivity tests have been carried out, the sensitivity and noise performance are both much better than the ZCI I used as reference. Audio output on an antenna which is about 30 feet long is more than adequate: with a quarter-wavelength, copious use of the gain controls is necessary. On very noisy signals, adjustment of the RF gain has improved the apparent signal-to-noise ratio considerably.

Reception of both CW and SSB signals is dead easy: AM is a bit more difficult. This is not a problem with the number of AM stations on 80 these days.

Use of direct-conversion techniques enables a high-performance receiver, free of the spurious responses that affect even the best superhets, to be built cheaply and easily by the novice and experienced amateur alike. They also can form the basis of a CW transceiver which is eminently suitable for AREC or WICEN work.

Synchrodyne . . . from P73

12. Adjust P3 and L5 for max, rejection of 10kHz.

13. Adjust P4 so that muting circuit comes into operation just at the onset of AGC voltage (check at collector of Tr1). Check that with 100% modulation no clipping occurs due to muting circuit. If it does, back off control sufficiently to avoid clipping.

Editor's note: While this article includes essential constructional details it is clearly a project suitable only for experienced hobbyists with access to the necessary test equipment. It is not a project for the novice. As it is a contributed article, we cannot provide further information via our Information Service.

A. C. E. RADIO

AMPLIFICATION · COMMUNICATION · ELECTRONICS

PHONE 51-3845
51-7008

136 VICTORIA RD., MARRICKVILLE NSW 2204

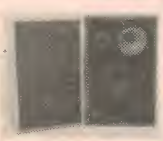
BSR STEREO RECORD CHANGERS

All current models, fully guaranteed. Now available at our new low prices
Standard Model 4 speed ceramic cartridge, sapphire stylus $32.50
As above with cueing device $35.00
Deluxe model with 11in turntable, cueing device, stylus pressure and adjustment also player spindle, ceramic cartridge, diamond stylus $39.00
Deluxe C142/G11202. 4 pole shielded pole motor, heavy duty turntable. Fully adjustable cueing device, bias compensator, changer/player spindle. Magnetic cartridge, diamond stylus $49.95
Pack and post NSW $1.45
Interstate $1.80
Beautiful teak or walnut pre-cut mounting base $12.50
Tinted, fully moulded perspex cover $10.50

BSR STEREO PLAYER MODEL P-128

Latest design 4-speed auto or manual operation. 11in heavy weight diecast turntable driven by fully shielded 4 pole dynamically balanced 240V motor. Noise suppressor. Silicone damped cueing device. Square section brushed aluminium pick up arm. Adjustable counterbalance. Calibrated stylus pressure control. Antiskate bias compensator fitted with magnetic cartridge, diamond stylus **$55.00**
P&P $1.50

PLAYMASTER 3-45L
LOUDSPEAKER SYSTEM

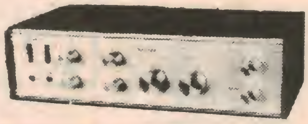


Features the mighty 8-30 woofer, 6J midrange and the incomparable Philips AD016/T8 tweeter. This top quality low cost 3 way hifi system is available from stock in either walnut or teak veneer and complies with the specs. as per April '75 EA.
$75.00 EACH
Special offer. 8-30, 6J and AD0160/T8 $30.00
Standard 8-30 system. Teak or walnut $67.50 each
Magnavox 6WR bookshelf system $32.50 each

WESTON 5 WATT CITIZENS BAND TRANSCEIVER

Suitable for bass and mobile. Auto noise limiter, squelch, A.G.C. Over modulation limiter, low pass filter for bandwidth. SPECS. T-mitter. Crystal locked. 5 watts input to RF stage. Freq. coverage. Any 11 channels in 27MHz band. Receiver, crystal locked, double superhet. 6.5Mc and 455Kc IFs 3" speaker, dynamic mic., 50 ohm antenna, 20 t'sistors, 8 diodes, 12V DC operation. Sensitivity, 0.5UV 10dB S/N. Size 6½" x 2½" x 7¾". Wt. 4½ lbs.
$133.50. P-P $2.00

SONATA NS-1600D

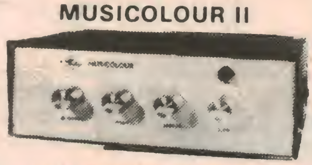


All silicon solid-state Hi-Fi Stereo Amplifier. 10 watts RMS per channel. Each channel has separate Bass Treble controls. Inputs for magnetic or ceramic cartridge, crystal mic, radio, tape—tape out, stereo headphones, 8-16 ohms instruction booklet circuit supplied. Timber cabinet. Dimensions 14½" x 8" x 4".
$74.50 plus freight $2.50.

GARRARD

Model SP 25 Mark 4, the newly released latest model—a beautiful machine 3 speed, 4 pole motor. Aluminium turntable. Fully balanced and CALIBRATED P.U. arm. Bias comp. cue & pause control. Click suppressor. Auto. set down.
Including Mag. Cartridge, Dia Stylus $75.95
Pack & Post N.S.W $1.50. Interstate $2.50.

MUSICOLOUR II



Operates in conjunction with your home Hi Fi or P.A System, and as the music plays, different coloured lights respond. The Musicolour II has three channels. The max number of coloured lights is not to exceed 1500 watts per channel
As per EA Dec '71. Jan '72. Complete kit of parts **$55.50**
Fully constructed **$65.50**
Pack & Post 75c

CABINET KITS

Teak veneer approx. 1.6cu.ft. The back, top and bottom and both sides are pre-assembled in the factory, which makes the finished job extra simple. Innerbond and speaker grille cloth included. Baffle board can be supplied pre-cut for either 12" or 8" speaker. Cabinet size 22¼" x 13½" x 11¾". **$26.00 EACH. $48.00 PAIR.**

STEREO MAGNETIC CARTRIDGE

Specifications
MODEL: ES-70S
Frequency Response: 15Hz 25,000Hz
Output Voltage: 5mv 1,000Hz/5cm/sec.
Channel Balance: With in 1.5db at 1,000Hz
Channel Separation: (Minimum) 20db at 1,000Hz
Compliance: 10 × 10 ⁶cm/dyne vert. and hori.
Impedance: 3,500ohms at 1,000Hz
Effective Tip Mass: 0.8milligrams
Tracking Force: 1 2.5grams
Stylus: Diamond, Conical, radius 16microns

Vertical Tracking Angle: 15Degree
Weight: 5grams
Overall Dimensions: 21 × 17 × 17.6mm
Mounting: 12.7mm or ½"
ONLY $5.95

KAISE MULTI-TESTERS

MODEL SK-44 30,000 OPV DC, 10,000 OPV AC
Specs. DC Volts—0.6, 3, 12, 60, 300, 600, 1200, 3000. AC Volts—6, 30, 120, 300, 1200. DC Current—30uA, 6mA, 60mA, 600mA. Resistance—10K, 1MEG, 10MEG, 100MEG. Decibels—20 + 17, 31, 43, 51, 63dB. Double Jewelled Meter with Mirror Scale. Overload Protected. Circuit Diagram. **$24.50.** P&P $1.00

MODEL SK-20 20,000 OPV DC, 10,000 OPV AC
Specs. DC Volts—0.25, 2.5, 10, 50, 250, 1000. AC Volts—10, 50, 250, 500, 1000. DC Current—50uA, 25mA, 250mA. Resistance—7K, 700K, 7MEG. Decibels—10 + 20/10V + 20 + 36/50V. Double Jewelled Meter with overload protection circuit diagram. **$18.95.** P&P $1.00

PLAYMASTER 143

High Performance 12.5 + 12.5 Watts Stereo Amplifier. For Full Particulars Ref. Sept./Oct. 74 Issues EA.
Complete Kit Top Quality Components **$72.50.** Fully Constructed, Thoroughly Tested **$87.50.**

SOUND COLUMNS

Black Vynex Covered Cabinets Rugged and Attractive, Innerbond Lined for Richer Sound. Excellent Frequency Response. 8 or 16 ohms. Three Models.

	15W RMS	25W RMS	40W RMS
	2 x 8" Speakers	4 x 6" Speakers	4 x 8" Heavy Duty Speakers
Size	19½"H 11"W 7"D.	33" x 10" x 10"	37" x 11" x 10"
	$35.00	$45.00	$59.00

PHILIPS MODEL N2209 CASSETTE TAPE RECORDER

Automatic recording level control system. 9 volt battery, 110V-240V (50 and 60Hz) AC. Output 750MW ± 1dB. Tape speed 1⅞ Ips. Freq. 60-10000Hz. (DIN) within 6dB. Sig./noise ratio 45dB (DIN). (Wow/flutter ± 0.4%. Input for mic., radio, amp. Telephone 0.2MV/2K ohms. 200 MV/1.5M. Record player, second recorder. 100MV/1 meg. Output for radio, amp., sec. recorder. 0.5V/20K. 215 x 171 x 58mm. 4 lbs. Complete with mic. leads, tape, big instruction book, circuit
SPECIAL $59.00. P&P $2.00

PA SPEAKERS

8 watt 8" Heavy Duty High Efficiency Speaker in Waterproof projection flare 8 or 15 ohms **$24.95**

PIANO BASS

Fully transistorised 240V operation. Keyboard C1-C3, 2 Octaves. Fine tuning adjustment control which matches piano bass to other instruments. Portable, in black vynox carry case. **$89.**

GUITAR AMPLIFIER

50 watts RMS solid-state guitar amplifier. PM125 4 inputs, 2 channel with separate volume, bass and treble controls; speed and intensity controls for vibrato. Remote foot switch with plug and lead. Black vynex carry cabinet. Fully constructed and ready for operation off 240VAC $125.50

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3 stage distribution amplifier. 75ohms. Ultra wide band. 20dB gain. **$57.80.**

4 way distribution amp. Ultra wide band. Ideal for domestic use, can drive Colour TV, BandW TV, FM radio, leaving spare for bedroom TV, etc. **$52.75.**

2 way low loss indoor—splitter/combiner. Operate 2 sets off 1 aerial. **$6.35.**

2 way outdoor splitter/combiner. Ideal for external connection of two antennas; complete with mounting accessories. **$7.70.**

Solderless co-ax plugs. Pack of 20. **$13.90.**

30ft lengths ½" and ¼" 75ohm co-ax cable. **$2.50. P-P 85c.**

240V 50Hz power t'former. Sec. 0-15, 0-27V, 50mA. **$3.50.**

MAGNAVOX WIDE RANGE TWIN-CONE SPEAKERS

8-16 OHMS 30-16,000Hz

6WR MK5 12W RMS		$9.90
8WR MK5 16W RMS	P&P	$10.75
10WR MK5 16W RMS	65c	$11.50
12WR MK5 16W RMS		$13.50

12" PLESSEY 50 WRMS

12U50. 20.11000 Hz. RES45Hz. $38.95
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ALL BAND COMMUNICATION RECEIVER. $290.00

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Stereo h'phones 8ohms vol. Controls, top grade $7.95
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2N 3055 t'sistors. 4 for $5.40
18½" x 15¼" x 1¼" tinted perspex fully moulded cover $4.50
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Power t'former. 240V AC 50Hz prim 285V. 250mA bridge. 2 x 35V IA, 1 x 6.3V, 4.5A, 1 x 6.3V IA, 1 x 25V IA $10.50
New electrolytics. 2200UF 63VW. 4 for **$3.00.** 4000 UF 85VW. 2 for **$6.00.** 4000 UF 80VW. 2 for **$4.00.**
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Mini 50pF. Var. caps. ¼" shaft $1.50
Audio leads. Length 2 metres, 5 pin din plug each end $2.25
5 pin din plug to 4 R.C.A. plugs $2.50
5 pin din plug to 5 pin din socket $2.00
5 pin din plug to 6.5m/m plug $1.35

INFORMATION CENTRE

MIXER: I have been reading your magazine since primary school 25 years ago. I particularly like your lucid way of explaining how a project works as well as its construction. You haven't had a car radio for some time. An IC design would be both interesting and popular. The "roll-your-own" series of converters was a style of design to be encouraged. Most builders adapt your designs to a minor or sometimes major degree to fulfil their own needs. May I suggest an audio mixer, with a flexible module system which could be arranged to suit many needs. Perhaps preamps for various pickups, high & low Z microphones, guitar, etc, and a master volume & VU meter, etc. Perhaps a preceding article on typical mixers for PA would interest many. (K.L., Auckland, NZ).

Thanks for the compliments, and your letter (which we had to condense somewhat!). Maybe you are a mind reader, K.L., or perhaps the adage "great minds think alike" is correct. As you must have seen by now, we have recently described such a mixer. Your suggestion for a car radio is noted, but we are not too hopeful. Car radios can be bought in Australia for as little as $19—it would be hard to get a decent case and IC for that much, let alone all the costly bits!

SW CONVERSION: I have an idea which I would like published in Circuit and Design Ideas or Elementary Electronics. It is this: A cheap transistor radio can be modified to receive short-wave signals by scraping some of the enamel from the ferrite rod coil with sandpaper, and coating the turns with a thin layer of solder. An antenna can be connected to one side of the coil. I received the Voice of America and Radio New Zealand with considerable strength. (N.T., Eaglehawk, Vic.)

We didn't publish your idea in the section requested because it has a number of quite serious errors. In fact, the whole approach is quite wrong in theory—any results you have obtained have been in spite of what you did, rather than because of it. First, you appear to have shorted out a number of turns on the aerial coil. While the idea of reducing the number of turns on the aerial coil is right—as far as it goes—this is the wrong way to do it; the shorted turns reduce the efficiency of the aerial coil quite seriously.

Secondly, you appear not to have modified the oscillator coil at all, and it is this coil which really determines the receiver's coverage.

While it is possible that you are forcing the set to receive "image" signals, these would extend to only 2.5MHz or thereabouts, and we know of no Voice of America or Radio New Zealand programs within this range.

In any case, whatever the explanation, we certaintly could not recommend that readers mutilate their receivers in this way.

POWER SUPPLY: I would like to ask your advice about a power supply. I used the A & R 2155 multitap transformer, a bridge rectifier and a 470uF filter capacitor. When I connect a DC voltmeter with the rectifier on the 6.3V AC tap, the DC is over 10V. Then when a small cassette tape recorder is connected a hum is detectable. What should I do about this?

Your magazine is the best I have read, so keep the good work up. (M.C., Broken Hill, NSW.)

Thank you for your kind comments about E.A. The type of transformer that you have mentioned has a regulation of approximately 24 per cent between no load and full load. This means that the open circuit voltage should be about 7.8V RMS. The output voltage from a rectifier is approximately 1.4 times the RMS input voltage, giving an output voltage of approximately 11V. On full load, this would fall to approximately 8.8V.

The above calculations assume that a very large filter capacitor is being used. With the size that you have used, the full load voltage would be expected to be even lower, and a significant amount of ripple would also be present on the output, as you have found. This could be minimized by increasing the size of the filter capacitance (say 10 times), although a better solution would be to use a regulated power supply.

A suitable design would be the Powerpac, which was featured in the July 1973 edition (File No. 2/PS/32). This design was also featured in our handbook, "Projects and Circuits". Similar devices are available commercially.

TV OSCILLOSCOPE: With reference to your recent article on a crystal controlled clock (File No 7/CL/14,15) and the December 1974 "Serviceman" column on the repair of a commercial clock, I recently

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

PRINTED BOARD PATTERNS: Dyeline transparencies, actual size but of limited contrast: $2. Specify positive or negative. We do not sell PC boards.

REPLIES BY POST: Limited to advice concerning projects published within the past 2 years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

BACK NUMBERS: Only as available. Within last 6 months, face value. 7-12 months, add 5c surcharge; 13 months or older, add 10c surcharge. Post and packing 60c per issue extra.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee, for reply in the magazine, at the discretion of the Editor.

COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

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32 piece metric brand new ½", ⅜" + ¼" drive ratchet ext bar, T bar plug spanner etc in metal case only $5.95 set. Post A 95c, B $1.10, C $1.25, C $1.35.

CIRCULAR SLIDE RULE
3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included
from $1.60 each
P & P 20c.

P.M.G. TYPE TELEPHONES
Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.
$29.50
(2 TELEPHONE SETS)
$1 cartage to rail. Freight payable at nearest attended railway station.

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Sensitive type ex Air-Force, made by Pioneer USA. $37.50.
Post: A $1.50, B $1.60, C $1.95, D $2.75.

TEN CHANNELS VHF TRANSCEIVER
Types TR 1934 100-125 MHz and TR 1936 125-150 MHz. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator. $33.00

MINIATURE ELECTRIC MOTORS
1½ to 3 volts DC. Ideal for model boats, cars, planes, etc. Strong torque. Only
75c each or 10 for $5
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Genuine Eight Day Jewelled movement, sweep second hand and start of trip indicator. Dash mountings. Ideal for car rallys.
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1000 ft reels brand new original packing
$4.00 ea. quantity available
Post A 79c, B $1.20, C $1.40, D $1.70

TELEPHONE WIRE
1 mile twin(2 miles) genuine ex-Army Don 8 perfect condition $35 per drum $1 cartage to rail freight payable at destination.

PRISMATIC COMPASSES
Genuine ex-army Mk 3, liquid damped, as new $35.00 P & P $1.05

MORSE KEY	MORSE KEY BUZZERS
$1.40 Post 20c.	$4.25 Post 55c.

HALF INCH RECORDING TAPE
Top Grade 2400' on 10½" reels. Ideal Video Experimenting. Only $3.50 per reel.
P & P A. $1.55, B $1.60
C. $1.95, D. $2.75.

UNI-SELECTORS
4 bank 25 position $4 each.
P & P A. 70c, B. 85c, C. $1, D. $1.10.

ADLER FREQUENCY METER
100KHz 20MHz $95

4 DIGIT RELAY COUNTERS
50 volt DC, suit slot car Lap counters, etc.
$1.25 each. P & P 30c.

NIBBLING TOOL
Cuts sheet metal like a punch and die, trims, notches and cuts to any size or shape over 7/16inch.
ONLY $7.85
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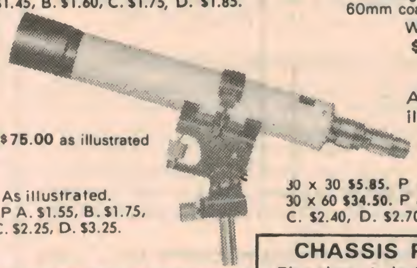
NIFE CELLS
1.2 Volt, fully charged, 4in x 3in x 1in 4 AH.
$1.50 each P & P 30c.

BC221
Frequency Meters.
$35.00

HANDY SIGNAL INJECTOR
Produces an Audio Signal in rich harmonics. Ideal for Sig Tracing in A.F., I.F., and R.F. circuits. Powered by 4 Penlight Batteries with On-Off Switch and indicator lamp. Size 1½" Diam. 5" Long. Only
$6.50 Post 55c

P.M.G. TYPE KEY SWITCHES.
45c P & P 20c

TELESCOPES ZOOM FOCUSING
25 x 30 $19.95 — 40 x 40 $28.95
50 x 50 $37.50
P & P A. $1.45, B. $1.60, C. $1.75, D. $1.85.



60 x 60 $75.00 as illustrated

As illustrated.
P & P A. $1.55, B. $1.75, C. $2.25, D. $3.25.

60 magnification with a 60mm coated objective lens
With tripod
$39.50

Ask for our illustrated leaflets

30 x 30 $5.85. P & P 55c.
30 x 60 $34.50. P & P A. $1.79, B. $2.20, C. $2.40, D. $2.70.

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INFORMATION CENTRE

purchased a crystal-controlled clock motor from Australian Time Equipment Pty Ltd for less than $50 (instead of building your project clock as I originally intended). This would have probably been an economical replacement for the Junghans clock repaired by "Serviceman".

Also I have been waiting for someone to suggest a project for converting a surplus black/white TV into a CRO. (No-one appears to have done this, so here it is.) Hopefully, timebase, X and Y amps would use IC's and calibrated axes (obtained by switching the input to reference voltages) instead of calibrating the amplifiers. Or is there too little of a TV set which can be used in this way to make this approach worthwhile? (Illegible signature, Woronora, NSW.)

Thank you for your comments regarding the clock. While, superficially, it may appear that the unit you mention could have been substituted, there are several reasons why it could not. The most important one was that it was not available at the time that the job was done. In addition, the owner had already committed himself for a new movement, before he realisd that the electronics of the device were also in need of repair. Finally, there is some doubt whether these lower cost movements have been made for use in the rolling environment encountered in a ship. Nevertheless, your comments present an interesting cost comparison.

While we have not published details on a full-scale conversion of a TV set to an oscilloscope, we have featured an article on how display waveforms on a TV screen, entitled, "Oscilloscopes and the Sampling Techniques" March 1963, 7/C/20. We agree that an updated project along these lines might be worth looking into, and will do so.

NOTES & ERRATA

ADD-ON STEREO DECODER (April 1975, File No. 1/MS/12). In some circumstances, it may be desirable to defeat the internal stereo-mono switching of the 1310 IC, for example when noisy conditions make mono reception undesirable. This may be done quite easily, by arranging for a SPST switch to either short-circuit pin 14 to ground (disabling the VCO oscillator), or to disconnect one end of the capacitor coupling pin 3 to pin 11 (removing input signals from the comparators). Either method is permissible, and both are effective.

VARIABLE DELAY WIPER (May 1975, File No. 3/MS/53). Readers having difficulty in preventing transients from triggering the 555 timer may find that a 0.01uF capacitor connected between pin 5 and the negative rail will effect a cure.

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actual size.

Literature available on request.

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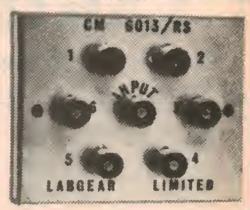

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CORRECTION

The Vicom International Pty Ltd advert on page 100 of the May issue showed an incorrect Sydney address. Readers with enquiries for Vicom International should direct them to the Melbourne address shown.

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